PNNL-13631

Pacific Northwest
National Laboratory
Operated by Battelle for the
U.S. Department of Energy

Sampling of Boreholes WL-3A through -12 in Support of the Vadose Zone Transport Field Study

G. V. Last
T. G. Caldwell
A. T. Owen

September 2001

Prepared for the U.S. Department of Energy
under Contract DE-AC06-76RL01830

PACIFIC NORTHWEST NATIONAL LABORATORY
operated by
BATTELLE
for the
UNITED STATES DEPARTMENT OF ENERGY
under Contract DE-AC06-76RL01830

Printed in the United States of America

PNNL-13631

Sampling of Boreholes WL-3A through -12 in Support of the Vadose Zone Transport Field Study

G. V. Last
T. G. Caldwell
A. T. Owen

September 2001

Prepared for
the U.S. Department of Energy
under Contract DE-AC06-76RL01830

Pacific Northwest National Laboratory
Richland, Washington 99352

Summary

This report presents the results of the fiscal year (FY) 2001 core sampling effort conducted to support the Vadose Zone Transport Field Study (VZTFS). The VZTFS has been conducting a series of controlled near-surface tracer tests at the 299-E24-111 Experiment Test-Well Site (also known as the Sisson and Lu site). The purpose of these tests is to address principal uncertainties affecting the understanding of current contaminant distributions under Hanford waste sites, and to improve the prediction of future migration through the vadose zone (Ward and Gee 2000). The FY 2001 tests were conducted using a concentrated sodium thiosulfate tracer (Ward and Gee 2001). Subsurface monitoring of the tracer test was conducted using various geophysical and geochemical methods.

This report presents the results from ten soil borings installed before, during, and after the tracer was injected. The first two soil borings were sampled seven days prior to the initiation of the tracer injections. Two more soil borings were sampled midway during the series of injections, and the remaining six soil borings were installed at three different times after the cessation of the injections. Over 300 soil samples were collected using a cone penetrometer and wireline sampling tools. The samples generally ranged in depth from 4.6 to 17.4 m (15 to 57 ft). Selected samples were analyzed for percent fines, moisture content, and/or tracer concentrations.

Preliminary results from the core sample analyses indicate that the major concentration front of the thiosulfate tracer reached a relative depth of at least 5.5 m (18 ft) below the injection point 17 days after the tracer injections began. Fifty-one days later the tracer appears to have migrated to a relative depth of at least 12.3 m (40.5 ft). Lateral spreading appears to have exceeded 5.8 m (19 ft) even at these deepest points of migration. These data will be used in combination with other geophysical and geochemical results to further our understanding of contaminant transport within the vadose zone.

Acknowledgments

The authors wish to thank the Vadose Zone Transport Field Study project team for support during execution of work described in this document. The Vadose Zone Transport Field Study project team is led by Andy Ward and Glendon Gee. We also wish to thank Eric Mcgarrah, Jason Ritter, Karen Waters-Husted, and Alex Mitroshkov for their field and laboratory support.

We especially wish to thank Wesley Bratton, Wilhelmina Dickerson, and John Mayhew of the Applied Research Associates, Inc. cone penetrometer crew for their ingenuity and perseverance at obtaining the core samples in some rather challenging locations.

Contents

Figures

Tables

Introduction

The Vadose Zone Transport Field Study (VZTFS) was initiated to study the principal uncertainties that affect the understanding of current contaminant distributions under Hanford waste sites and to improve the prediction of future migration through the vadose zone (Ward and Gee 2000). This study called for a series of controlled near-surface tracer tests to be conducted at the 299-E24-111 Experiment Test-Well Site (also known as the Sisson and Lu site) in fiscal year (FY) 2000 and 2001. This site was the location of a controlled contaminant transport study conducted in 1980-81 (Sisson and Lu 1984) as well as a series of water and tracer tests conducted in FY 2000.[1]

The FY 2001 tests were a series of controlled injections of a tracer with a high concentration of salt (Ward and Gee 2001). The injected fluid was a concentrated sodium thiosulfate pentahydrate solution. Subsurface monitoring of the tracer used various geophysical and geochemical methods. Core sampling was used to determine selected physical, hydrologic, and geochemical properties. This report presents the results of the core sampling efforts.

Sampling Locations

The VZTFS sampling and analysis plan (Ward and Gee 2001) called for the installation and near continuous sampling of four cone penetrometer boreholes, using wireline sampling techniques. However, a total of ten boreholes were actually sampled (Figure 1). Thus, the actual numbering of the boreholes varies somewhat from that planned.

The sampling and analysis plan (Ward and Gee 2001) generally called for continuous sampling to a depth of 18 m (60 ft). Subsamples (e.g., individual liners within the sampler) would then be selected from stratigraphic units of interest and analyzed for chemical, physical, and hydrogeologic characteristics. Samples were actually collected (nearly continuously) from depths of 4.5 m (15 ft) to between 15 m (49 ft) and 17.3 m (57 ft) in depth.

The first two soil borings were sampled seven days prior to the initiation of the tracer injections. Two more soil borings were sampled midway during the series of injections, and the remaining six soil borings were installed at three different times after the cessation of the injections. Table 1 summarizes the pertinent sampling information for each borehole.

[1] Results are available online at http://vadose.pnl.gov

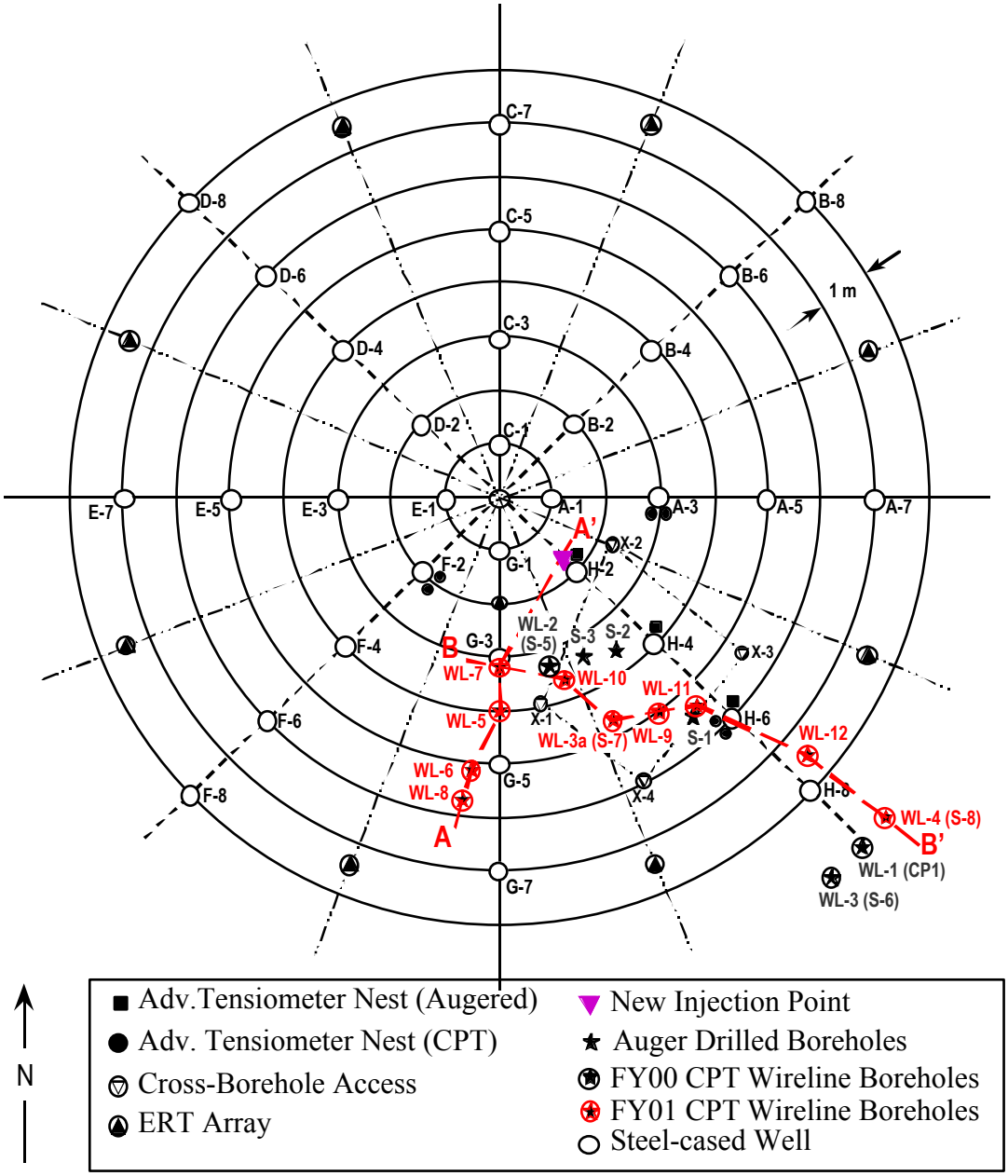


Figure 1. Location of Boreholes and Cross Sections at the Vadose Zone Transport Field Study Site

Table 1. Soil Sampling, Injection Dates, and Other Pertinent Sampling Information

Date	Borehole	Sampled Interval	Number of Samples Collected
3/23/01	WL-3A (S-7)	4.6 – 16.7 m (15 – 55 ft)	40
3/23/01	WL-4 (S-8)	4.6 – 16.2 m (15 – 53 ft)	22
3/30/01	First Injection (1,957 L [517 gal] of sodium thiosulfate and sodium chloride solution)		
4/3-5/01	Second Injection (5,677 L [1,500 gal] sodium thiosulfate and sodium chloride solution)		
4/11-12/01	Third Injection (3,785 L [1,000 gal] sodium thiosulfate and sodium chloride solution)		
4/16/01	WL-5 (S-9)	4.6 – 14.9 m (15 – 49 ft)	34
4/16/01	WL-6	4.6 – 16.7 m (15 – 55 ft)	38
4/18-19/01	Fourth Injection (3,785 L [1,000 gal] sodium thiosulfate and sodium chloride solution)		
4/25-26/01	Fifth Injection (3,785 L [1,000 gal] sodium thiosulfate and sodium chloride solution)		
5/2/01	Sixth Injection (3,785 L [1,000 gal] river water)		
5/2/01	Seventh Injection (3,785 L [1,000 gal] river water)		
5/9/01	Eighth Injection (3,785 L [1,000 gal] river water)		
5/09/01	WL-7	4.6 – 15.8 m (15 – 52 ft)	35
5/10/01	WL-8	4.6 – 16.4 m (15 – 53.7 ft)	39
5/23/01	WL-9	4.6 – 17.4 m (15 – 57 ft)	41
5/23/01	WL-10	4.6 – 17.1 m (15 – 56 ft)	40
6/05/01	WL-11	4.6 – 17.4 m (15 – 57 ft)	40
6/08/01	WL-12	4.6 – 17.1 m (15 – 56 ft)	41
Total Number of Samples			308

Sampling Methodology

Each borehole was sampled using a cone penetrometer and wireline sampling tools. Once set up over the desired location, a dummy tip was initially pushed to 4.5 m (15 ft). The dummy tip was then with-drawn and the sampling unit lowered in its place. The unit was pushed 30 cm (1 ft) and the sample retrieved. The sampler was 2.5 cm (1 in.) in diameter and 30 cm (1 ft) long. Upon retrieval, the sample barrel was removed from the sampler assembly and the percent recovery recorded. The sample materials were then removed from the sample barrel, by knocking them loose to fall into a plastic bag, or by digging them out using a large screwdriver. Each plastic bag sample was labeled with a unique sample

number consisting of the borehole number, depth interval, and the date of sample collection. The samples were then placed in an ice chest with blue ice for transport the laboratory. This sampling procedure was similar to that tested in FY 2000.[1]

Geologic Descriptions

Sample materials were examined both during removal from the sample barrel and again once in the sample bag. The sample materials were generally disaggregated and showed no sedimentary structure. Visual descriptions were made of the moisture content, any residual sedimentary structure, and the dominant grain size(s). Each sample also was subjectively assigned to one of nineteen sediment types based on the modified Folk (1968) and Wentworth (1922) classification scheme historically used at the Hanford Site (Figure 2) and described by Fecht, Last, and Marratt (1978). This information was noted on daily borehole logs in accordance with PNNL procedure PNL-MA-567, DO-1. Where sample recovery was good, a small aliquot was collected from the sample bag and placed in a chip tray for future detailed geologic description in the laboratory.

Once back at the laboratory, the chip tray samples were further examined for grain size, color, gross mineralogy/lithology, and reaction to hydrochloric acid, again in accordance with PNNL procedure PNL-MA-567, DO-1 and ASTM D 2488. Detailed borehole logs are presented in Appendix A.

Note that the geologic materials above a depth of 4.6 m (15 ft) were not sampled. The materials penetrated below this depth generally consisted of stratified sand deposits, with variable silt content and rare pebbles. Last and Caldwell (2001) reported that these materials were consistent with the third layer (Layer 3) of a sandy sequence described by Reidel and Horton (1999) within the uppermost Hanford formation beneath the southeast portion of 200 East Area. The latest ILAW borehole 299-E24-21 confirmed the presence of a thick bedded sand sequence from near the surface to ~91.5 m (300 ft) depth.

The near continuous nature of the samples and the ability to observe all of the sampled materials, albeit with limited observation of the sedimentary structures, has lead to increased understanding of the nature and continuity of the geologic materials. Last and Caldwell (2001) grouped these materials into eight general lithostratigraphic units. However, the detailed information derived from these new boreholes suggests that the three middle units described by Last and Caldwell should be combined, resulting in six (not eight) fairly distinct and correlative units. Also, the sediment classification for these units provided by Last and Caldwell has been modified to reflect the newly acquired sieve data (see Section 6).

[1] Bratton, Wesley L, and Wilhelmina Dickerson. August 2000. *Vadose Zone Transport Field Study, Cone Penetrometer Tests, ERT, Advanced Tensiometer, and Well Installation at the Sisson and Lu Site*. ARA Report No. 0099. Applied Research Associates, Inc., Richland, Washington.

Each of the six generalized lithostratigraphic units is briefly described in Table 2. The depth of the lithostratigraphic contacts for each of these units is provided in Table 3. Two cross sections are shown in Figure 3.

PARTICLE DESIGNATION			PARTICLE DIAM. (MM)
GRAVEL	BOULDER		>256
	COBBLE	LARGE	256-128
		SMALL	128-64
	PEBBLE	VERY COARSE	64 - 32
		COARSE	32 - 16
		MEDIUM	16 - 8
		FINE	8 - 4
		VERY FINE	4 - 2
SAND		VERY COARSE	2 - 1
		COARSE	1 - 1/2
		MEDIUM	1/2 - 1/4
		FINE	1/4 - 1/8
		VERY FINE	1/8 - 1/16
MUD	SILT & CLAY		<1/16

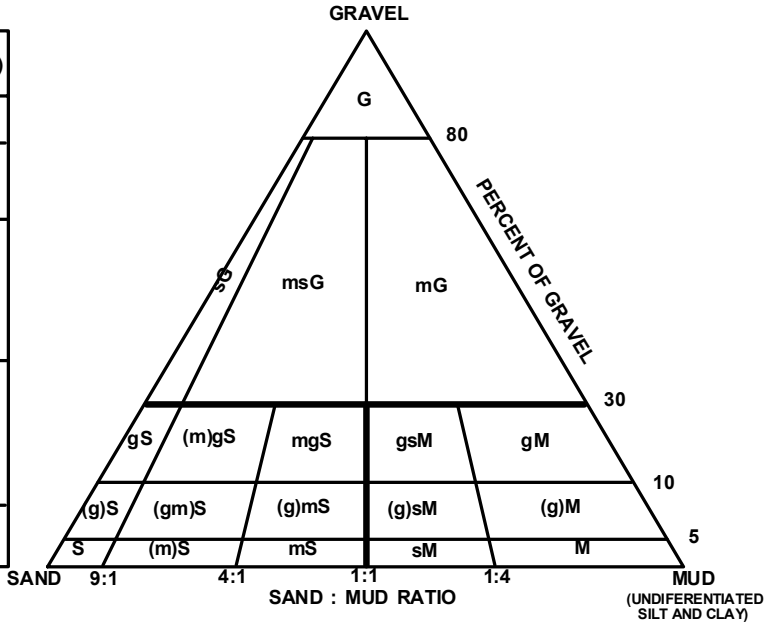


Figure 2. Grain Size Nomenclature (after Wentworth 1922) and Sediment Classification Scheme (modified after Folk 1968) Used at the Hanford Site

Borehole Decommissioning

Following the collection of the final sample, the cone penetrometer rods were removed and the boreholes backfilled with a neat cement grout consisting of approximately 1.5 bags (64 kg [141 lb]) of Portland Type II cement to 76-83 L (20-22 gal) of water. The total volume of grout used (~122 L [3.2 gal]) compares fairly well with the estimated volume of the boreholes (121-140 L [3.2-3.7 gal]). Thus, the integrity of the grout seals is believed to be acceptable, especially in the upper portions of the borehole, where it is most critical. Appendix A illustrates the general borehole construction and decommissioning details for each borehole.

Table 2. General Description of Materials Penetrated by Boreholes WL-5 through -12 (modified after Last and Caldwell 2001)

Approximate Depth Range (m/ft)	General Description	Reaction to HCl (per ASTM D 2488)	% Fines Determined in Laboratory (Ave. ± 1 SD)
0-4 m (0-13 ft)	***UNIT A*** **- GRAVELLY SAND.** Not sampled.	NA	NA
4-6 m (13-19 ft)	***UNIT B*** **- POORLY LAMINATED SLIGHTLY MUDDY MEDIUM SAND (CORRELATIVE WITH THE UPPER MOST SAND UNIT DESCRIBED BY LAST AND CALDWELL [2001])**. This unit consists of mostly medium sand, generally ranging from coarse to fine sand with an occasional very fine pebble. The sand has been visually described as fairly clean, ranging from virtually no mud (silt) to a trace of mud (silt) and/or very fine sand, however, wet sieving has found an average mud (fines) content of about 15.3 wt%. Sedimentary structures are generally not obvious, with the exception of occasional laminations of coarse and fine sand. A thin (2.5 cm [1in.] thick) very fine sand to silt unit was identified near the bottom of this unit is borehole WL-12. Last and Caldwell (2001) also reported some upward fining sequences. The color is generally light gray with some grayish brown reported by Last and Caldwell (2001). The coarser sand fractions exhibit a "salt and pepper" texture due to the abundance of both mafic and felsic grains. Some micas have also been noted.	None to Strong	15.3 ± 1.8
6-7 m (19-23 ft)	***UNIT C*** **- WELL STRATIFIED SLIGHTLY MUDDY TO MUDDY COARSE TO MEDIUM SAND (CORRELATIVE WITH THE UPPER MOST SAND TO SLIGHTLY SITE SAND DESCRIBED BY LAST AND CALDWELL [2001])**. This unit is generally about 1.5 m (5 ft) thick, but thins to only thin 0.8 m (2.5 ft) thick in borehole WL-12. It generally consists of coarse or coarse to medium sand stratified with fine to very fine sand in 2.5 to 5 cm (1 to 2") thick layers. The coarser strata are generally light gray to light brownish gray and exhibit the same "salt and pepper" texture described above. However, the finer grained strata are brownish gray to dark grayish brown (when wet). This unit generally contains more mud (fines) than the above unit.	Weak to Strong*	17.2 ± 2.8
7-10 (22-32 ft)	***UNIT D*** **- WEAKLY STRATIFIED MEDIUM SAND (CORRELATIVE WITH THE THREE MIDDLE SAND, AND SAND TO SLIGHTLY SILTY SAND UNITS DESCRIBED BY LAST AND CALDWELL [2001])**. This unit is generally about 2.4 m (8 ft) thick, but thickens to 3 m (10 ft) in borehole WL-12. This unit generally consists of medium sand which coarsens upward to coarse to medium sand and fines downward to medium to fine sand. Last and Caldwell (2001) broken this unit up into three units. However, evidence from these new boreholes suggests that the variation in materials is gradational, so there is no clear differentiation between where one of these "subunits" ends and another begins. Thus, these materials have been combined into one unit. The upper portion of this unit is generally a weakly laminated, mostly coarse to medium sand exhibiting "salt and pepper" texture. Occasional coarse sand strata (on the order of 2.5 cm [1 in] thick) and scattered very fine pebbles have been observed. The overall color is generally described as light gray to gray, although Last and Caldwell reported some grayish brown to dark grayish brown. These coarser materials appear to grade downward to a lighter color with less mafics, and some mica. The middle portion of this unit is mostly medium or medium to fine sand with an occasional very fine pebble (e.g. WL-9) and some mud. The overall color changes from light gray to brownish gray of even dark grayish brown when wet. Last and Caldwell observed some weakly cemented clods that reacted strongly to HCl. The lower portion of this unit grades downward to medium to fine or fine sand, with some laminations and limonitic staining observed.	None to Strong*	7.8 ± 2.5
10-12 (32-39 ft)	***UNIT E*** **- HIGHLY STRATIFIED SLIGHTLY MUDDY TO MUDDY COARSE SAND (CORRELATIVE WITH SAND TO SILTY SAND DESCRIBED BY LAST AND CALDWELL [2001])**. This unit is generally 2.1 m (7 ft) thick, thinning to 1.7 m (5.5 ft) at borehole WL-11. The material is highly stratified, consisting of clean (no fines) coarse sand units on the order of 30 cm (1 ft) or more thick, to muddy very fine sand units on the order of 2.5 cm (1 in) thick. One of these muddy sand units is 15 cm (6 in) thick, contains up to ~28% mud (silt + clay), and can be correlated between at least three boreholes (WL-9, -10, -11). Some of the strata contain obvious muddy as well as occasional very coarse sand laminations. Last and Caldwell reported weakly cemented clods that react strongly to HCl near the top of this material. The overall color of this material generally light brownish gray to dark grayish brown (when wet).	Weak to Strong*	18.5 ± 4.7
12-17 (39-56 ft)	***UNIT F*** **- SAND TO SLIGHTLY MUDDY SAND**. This material is weakly stratified, consisting mostly of coarse and medium sand with variable mud content and scattered pebbles. Strata of coarse to very coarse sand are common. However, fine sand strata are uncommon. Individual strata appear to range on the order of 7 cm (2-3 in) to perhaps as much as 60 cm (2 ft). The overall color generally ranges from light gray to light brownish gray or brownish gray (when wet).	None to Strong*	12.6 ± 2.4

*Note: Reaction to HCl may have been at least partially in response to the presence of the sodium thiosulfate and sodium chloride tracer.

Table 3. Lithostratigraphic Contacts

Borehole	Depth to Top of Lithostratigraphic Unit (m [ft])					
	Unit A	**Unit B**	**Unit C**	**Unit D**	**Unit E**	**Unit F**
WL-3A (S-7)	0	NA	5.8 (19)	7.3 (24)	9.8 (32)	11.9 (39)
WL-4 (S-8)	0	NA	5.8 (19)	6.6 (21.5)	9.6 (31.5)	11.6 (38)
WL-5 (S-9)	0	NA	5.8 (19)	7.3 (24)	9.8 (32)	11.9 (39)
WL-6	0	NA	5.8 (19)	7.3 (24)	9.8 (32)	11.9 (39)
WL-7	0	NA	5.8 (19)	7.3 (24)	9.8 (32)	11.9 (39)
WL-8	0	NA	5.8 (19)	7.3 (24)	9.8 (32)	11.9 (39)
WL-9	0	NA	5.8 (19)	7 (23)	9.8 (32)	11.6 (38)
WL-10	0	NA	5.8 (19)	7 (23)	9.8 (32)	11.9 (39)
WL-11	0	NA	5.8 (19)	7 (23)	9.9 (32.5)	11.6 (38)
WL-12	0	NA	5.8 (19)	6.6 (21.5)	9.6 (31.5)	11.6 (38)
NA = Not available because sampling began at 15' depth within Unit B.						

Laboratory Analyses

Laboratory analyses consisted of water content, percent fine material, and tracer concentration. Percent fines (silt and clay fraction) were determined by wet sieving through a #270 sieve (0.053 mm). Results are presented in Appendix B.

The gravimetric water content (g_{water}/g_{soil}) was determined by weight loss after oven drying at 105°C for 24 hrs per PNNL procedures (PNL-MA-567-S7 Water Content). Approximately 200 g of soil from each sub-sample was transferred into containers and prepared for moisture content measurements. Tare and soil weights were recorded before and after the samples were dried. Results are presented in Appendix C. The remaining portions of each sub-sample (after removal of the 100 g for moisture content) also were oven dried overnight and used for the tracer analyses.

Tracer analyses were conducted using 1:1 extracts of soil/water (Methods of soil analysis, part 2; 62-1.3.2.2), and ionic chromatography (IC) analysis using method (IC-2 PNL Test Method for anions in water by ion chromatography). For the extractions, 50 g of both soil and deionized (DI) water were measured and placed in containers. The containers were closed and put on a mechanical shaker for 2 hours. After 2 hours, the shaker was stopped and the extracts were allowed to settle overnight. The water was then decanted into centrifuge tubes and placed in a centrifuge for 30 minutes. The samples were then filtered through a 0.45 μm syringe filter in preparation for IC analysis. A 10 ml aliquot of each filtered solution was added to scintillation vials and sent for IC analysis. The primary constituents of interest were chloride, bromide, and thiosulfate. Analytical results for all samples are presented in Appendix D.

Figures 5 through 9 illustrate the water content and tracer concentrations for five different time slices.

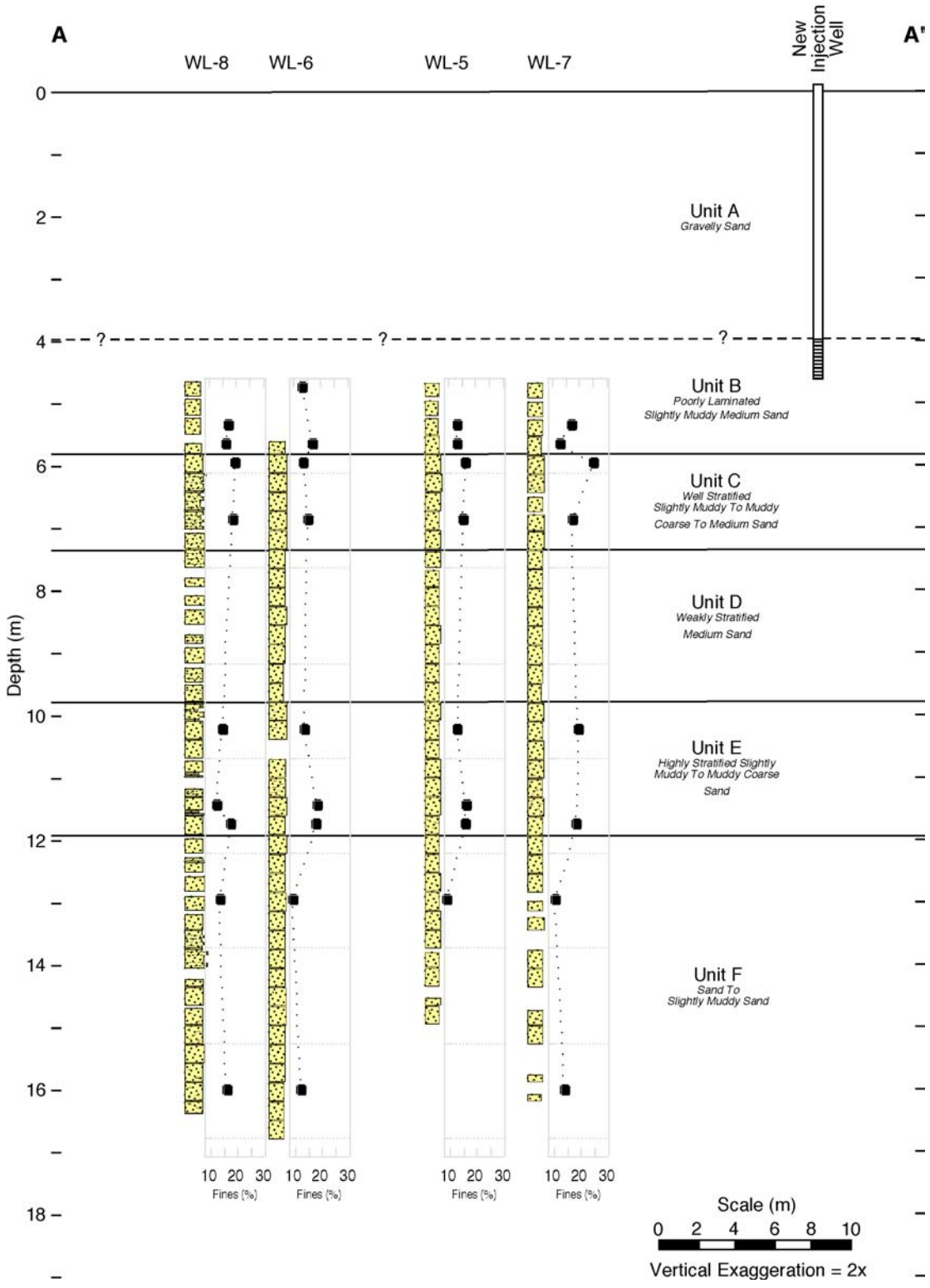


Figure 3. Lithostratigraphic Cross Section A-A' Showing the Relative Percent Fines (See Figure 1 for location of cross sections.)

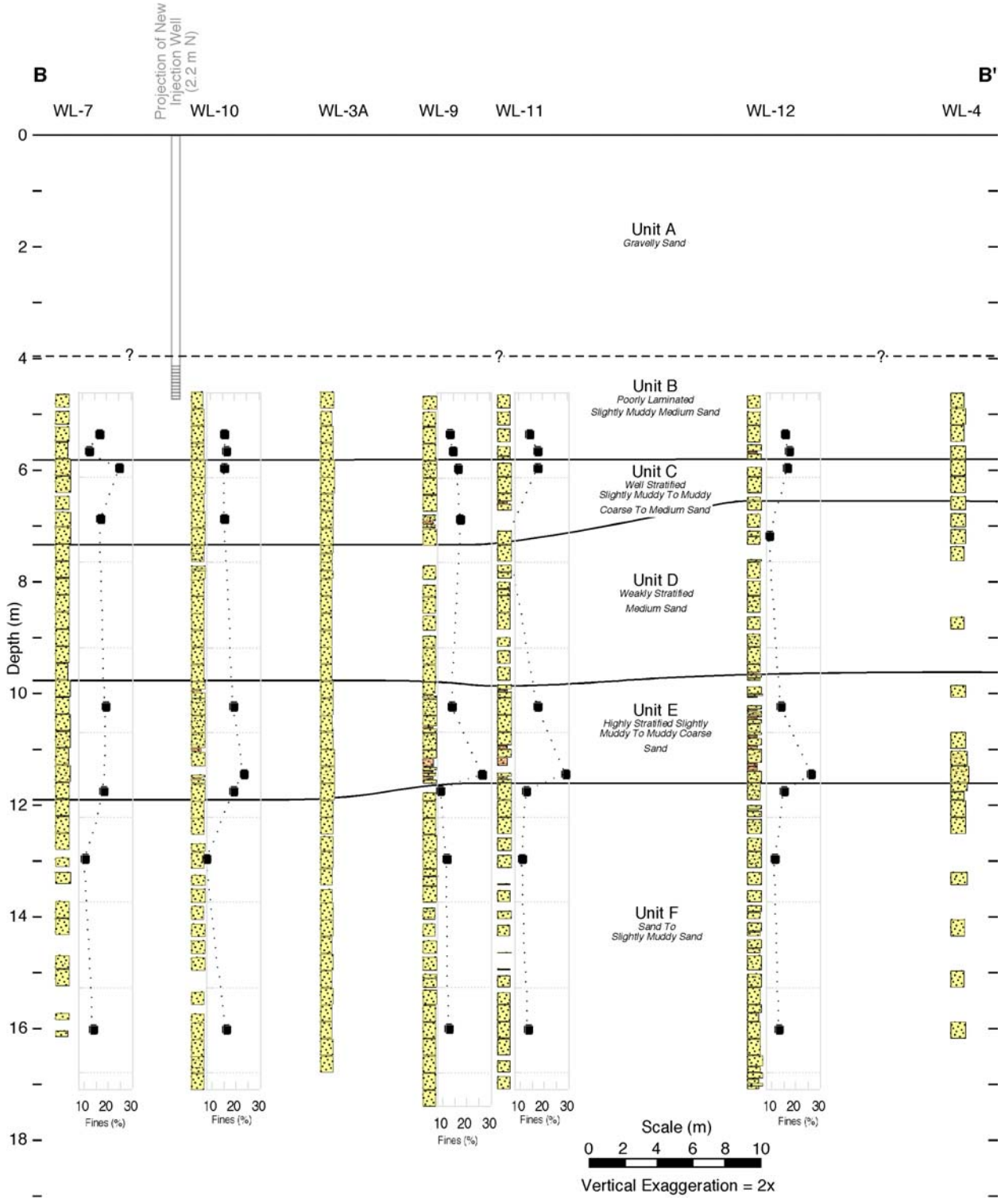


Figure 4. Lithostratigraphic Cross Section B - B' Showing Relative Percent Fines (See Figure 1 for location of cross sections.)

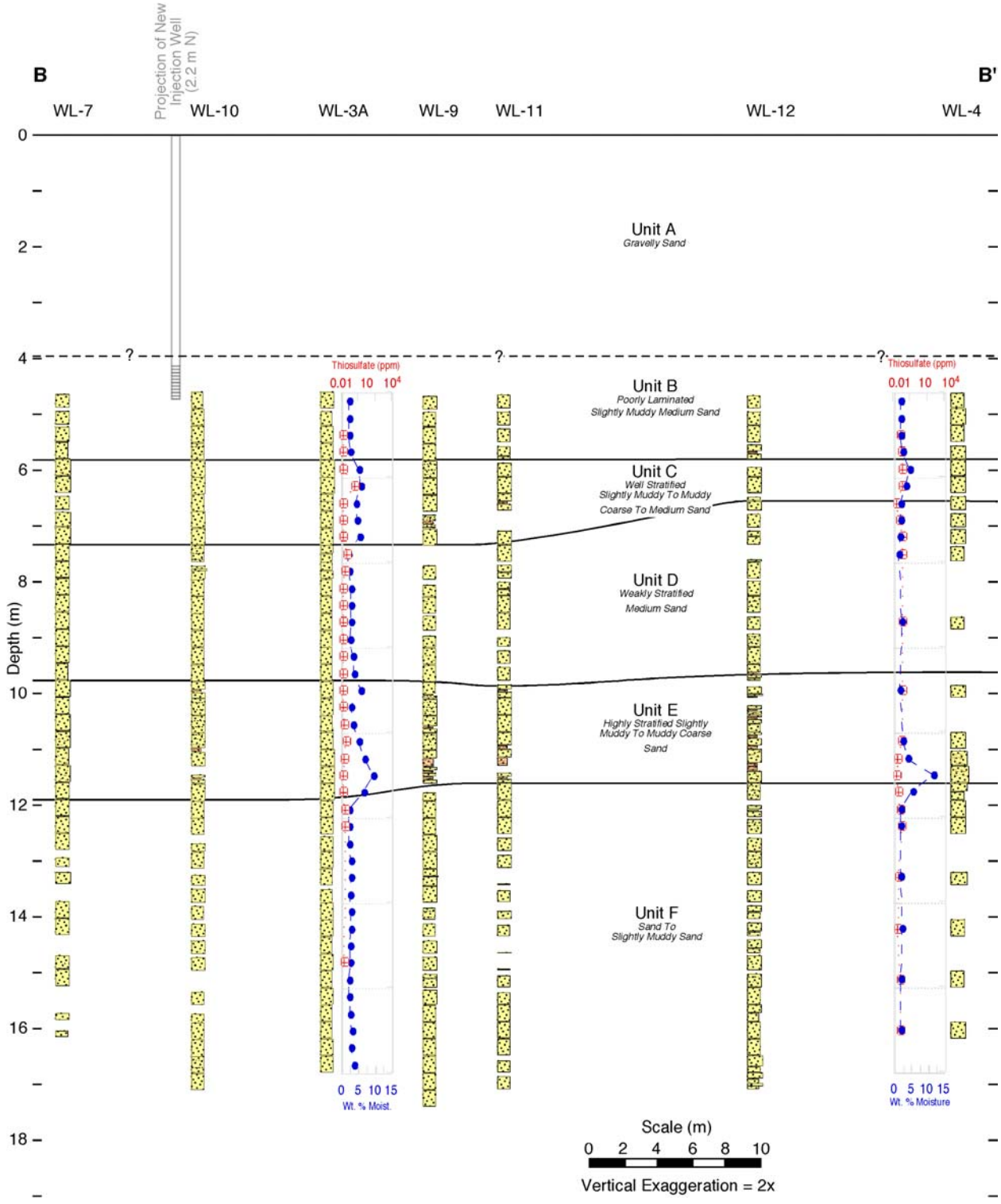


Figure 5. Water Content and Thiosulfate Concentration 7 Days Before Injections Began

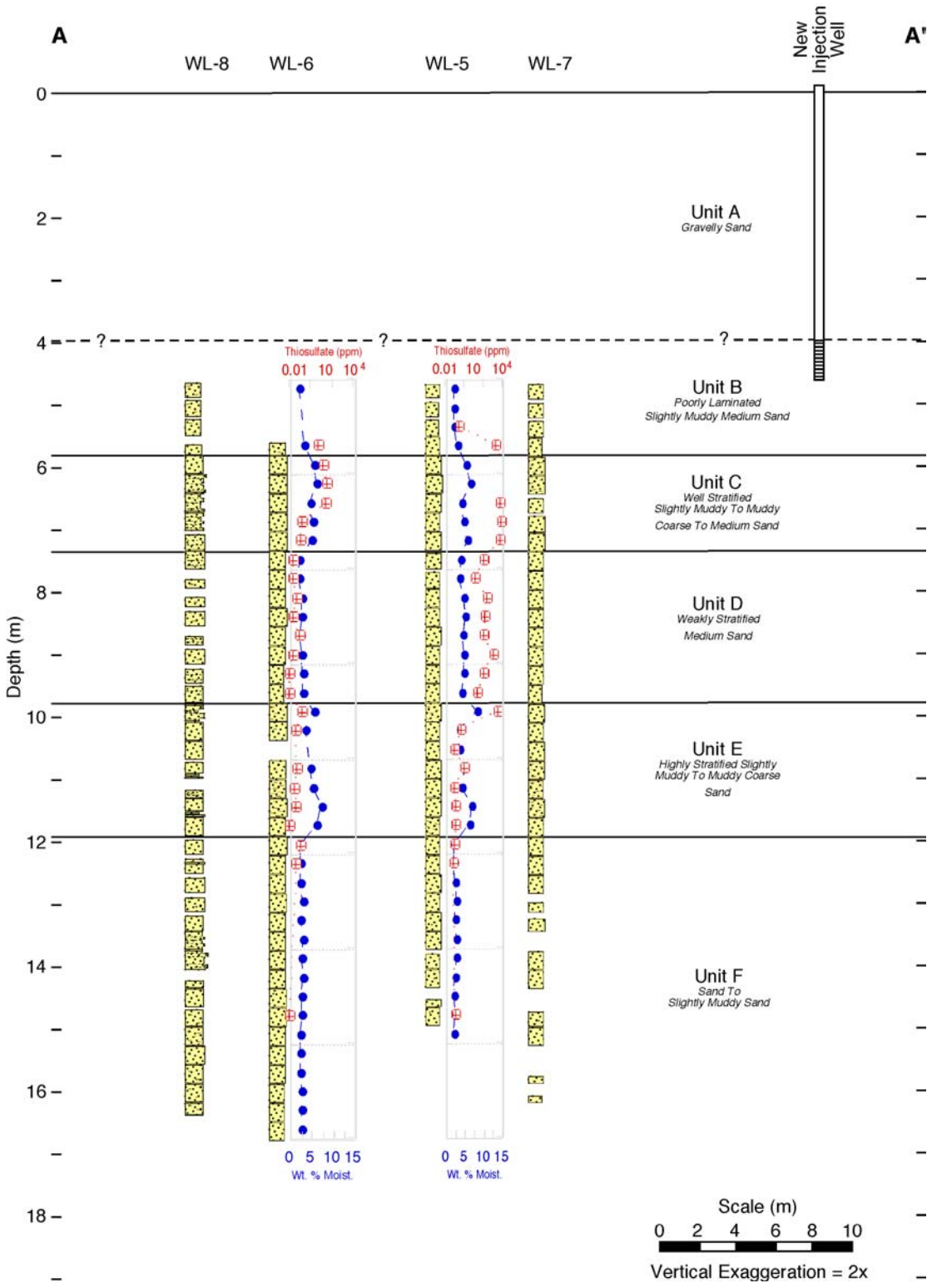


Figure 6. Water Content and Thiosulfate Concentrations 17 Days After the Injections Began

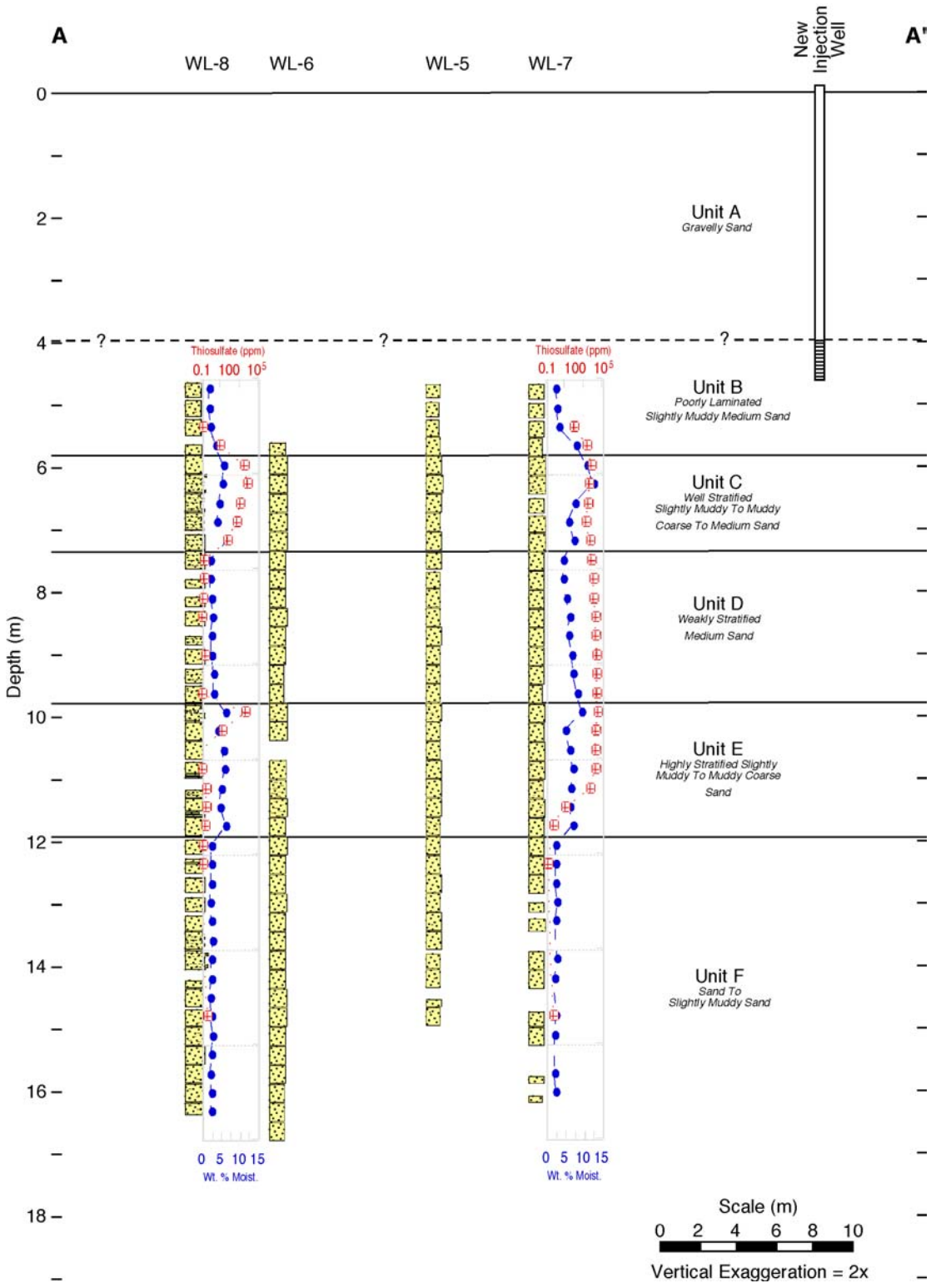


Figure 7. Water Content and Thiosulfate Concentrations 40 Days After Injections Began

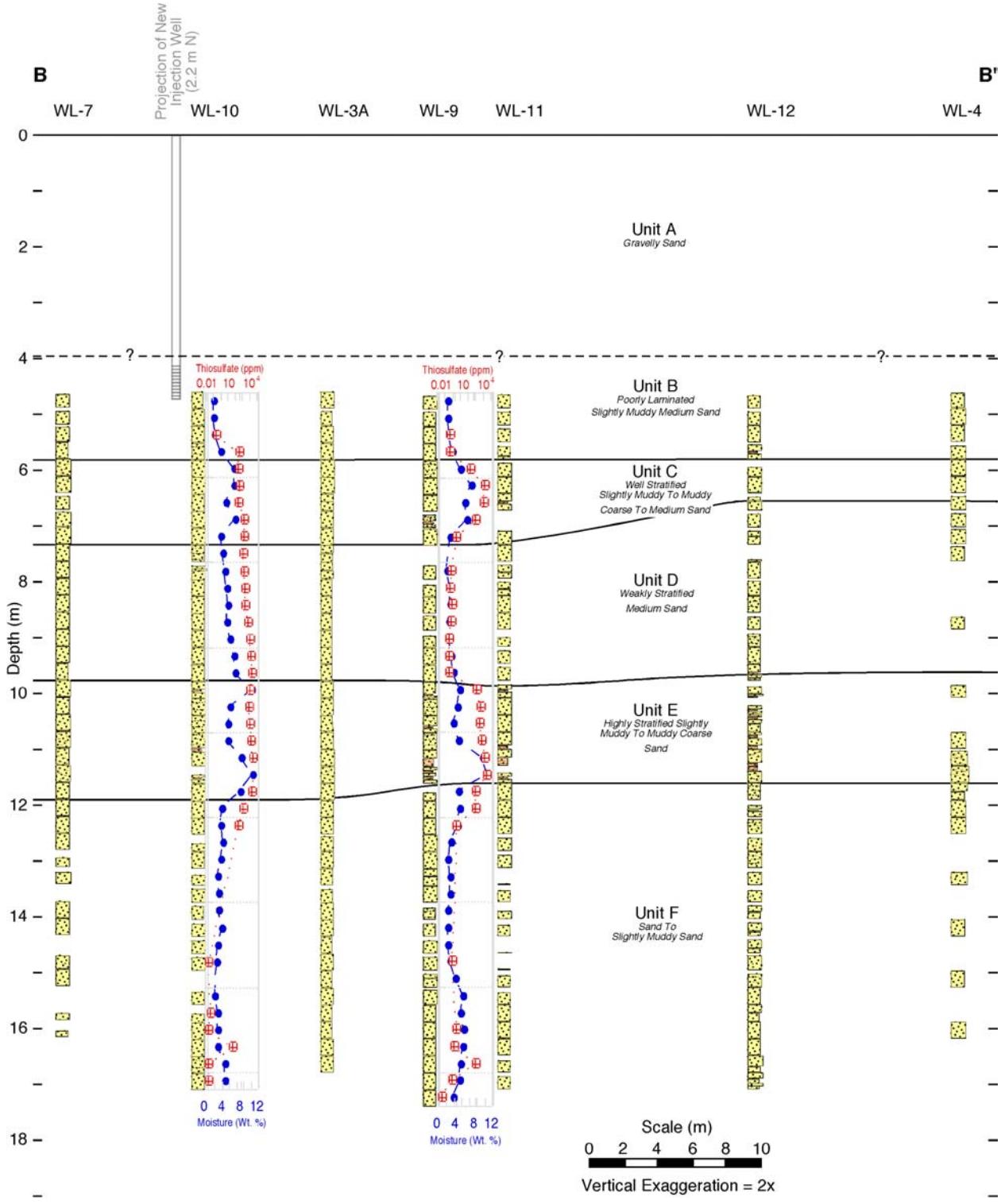


Figure 8. Water Content and Thiosulfate Concentrations 54 Days After Injections Began

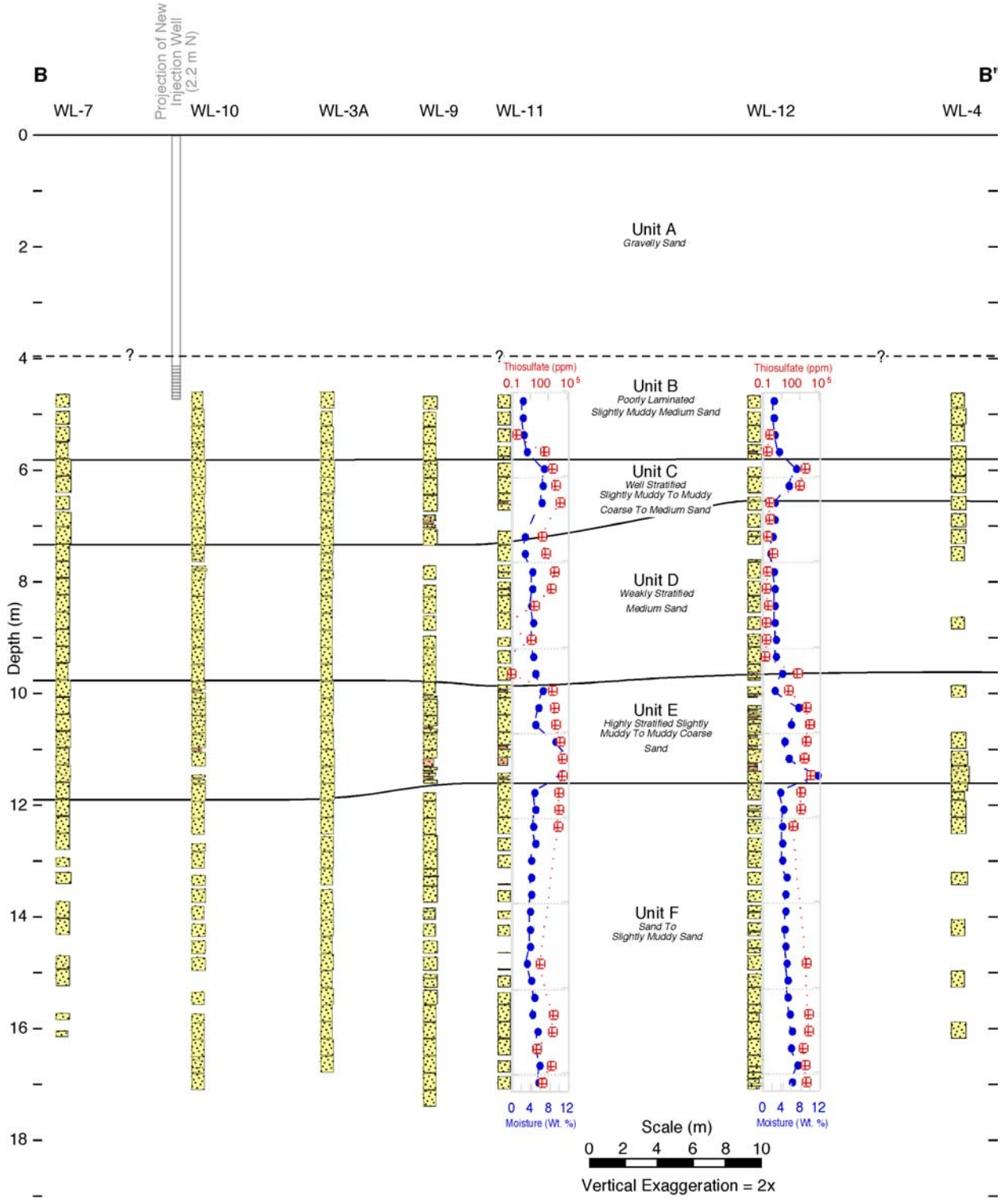


Figure 9. Water Content and Thiosulfate Concentrations 68 Days After Injections Began

Discussion

Figures 5 through 9 illustrate the water content and thiosulfate concentration profiles before, during, and after the series of injections. These results indicate that by 17 days after the injections began, the thiosulfate tracer had penetrated to depth of at least 10.1 m (33 ft). The greatest amount of lateral spreading appears to have taken place along the contact between units B and C, with the tracer extending laterally at least 4.3 m (14 ft) from the point of injection.

Forty days after the injections began the tracer had penetrated to a depth of at least 11.6 m (38 ft), and had spread laterally at least 5 m (16.4 ft) within unit C as well as along the contact between units D and E. Within 54 days, the tracer had penetrated to a depth of at least 12.5 m (41 ft).

Sixty-eight days after the injections began, and 30 days after injections were terminated, the tracer had penetrated to a depth of at least 16.9 m (55.5 ft). Lateral spreading exceeded 5.8 m (19 ft) in both fine grained units C and E as well as the deepest unit (unit F).

Conclusions

Over 300 soil samples were collected from ten soil borings installed to gather data from the second (FY 2001) tracer injection test conducted at the Sission and Lu (299-E24-111 Experimental Test Well) site in support of the VZFTS. The first two soil borings were sampled 7 days prior to the initiation of the tracer injections. Two more soil borings were sampled midway during the series of injections, and the remaining six soil borings were installed at three different times after the cessation of the injections.

All soil samples were collected using a cone penetrometer and wireline sampling tools with a 2.5 cm (1 in.) diameter and 30 cm (1 ft) long sampling tube. The samples generally ranged in depth from 4.6 to 17.4 m (15 to 57 ft). Selected samples were analyzed for percent fines, moisture content, and/or tracer analyses.

Preliminary results indicate that the major concentration front of the thiosulfate tracer reached a relative depth of at least 5.5 m (18 ft) below the injection point 17 days after the tracer injections began and had migrated to a relative depth of at least 12.3 m (40.5 ft) 51 days later. Lateral spreading appears to have exceeded 5.8 m (19 ft) even at the deepest points of migration.

These data will be used in combination with other geophysical and geochemical results to further our understanding of contaminant transport within the vadose zone.

References

ASTM – American Society for Testing and Materials. 1993. "Standard Practice for Description and Identification of Soils (Visual-Manual Procedure D2488)" *Annual Book of ASTM Standards*, Philadelphia, Pennsylvania.

Fecht, K. R., G. V. Last, and M. C. Marratt. 1978. *Granulometric Data, 216-A Crib Facilities Monitoring Well Sediments*. RHO-LD-44. Rockwell Hanford Operations, Richland, Washington.

Folk, R. L. 1968. *Petrology of Sedimentary Rocks*. University of Texas, Austin, Texas.

Last, G. V. and T. G. Caldwell. 2001. *Core Sampling in Support of the Vadose Zone Transport Field Study*. PNNL-13454. Pacific Northwest National Laboratory, Richland, Washington.

Reidel, S. P. and D. G. Horton. 1999. *Geologic Data Package for 2001 Immobilized Low-Activity Waste Performance Assessment*. PNNL-12257, Rev. 1. Pacific Northwest National Laboratory, Richland, Washington.

Sission, J. B. and A. H. Lu. 1984. *Field calibration of computer models for application to buried liquid discharges: A status report*. RHO-ST-46P. Rockwell Hanford Operations, Richland, Washington.

Ward, A. L. and G. W. Gee. 2000. *Vadose Zone Transport Field Study: Detailed Test Plan for Simulated Leak Tests*. PNNL-13263. Pacific Northwest National Laboratory, Richland, Washington.

Ward, A. L. and G. W. Gee. 2001. *Vadose Zone Transport Field Study: FY 2001 Test Plan*. PNNL-13451, Rev. 1. Pacific Northwest National Laboratory, Richland, Washington.

Wentworth, C. K. 1922. "A Grade Scale and Class Terms for Clastic Sediments" in *Journal of Geology*, Vol. 30, p 377-392.

Appendix A

Borehole Logs

Pacific Northwest National Laboratory	**BOREHOLE LOG**	Boring/Well No: WL-3A (S-7)	Depth 0-55'	Date 3/23/2001	Sheet 1 of 1
		Location: Sisson & Lu Site, 200 East Area	Project: VZTF Study		

Logged by T. G. Caldwell (Print / Sign) — **Drilling Contractor** Applied Research Assoc.

Reviewed by (Print / Sign) — **Date** — **Driller** Willi Dickerson / John Mayhew

Lithologic Class. Scheme Folk/Wentworth — **Procedure** PNL-MA-567, DO-1 — **Rev** 1 — **Rig/Method** CPT with Wire Line Sampler

Steel Tape/E-Tape NA / NA — **Field Indicator Equip.** 1) NA 2) NA — **Depth Control Point** Ground Surface

DEPTH (Ft.)	TIME	SAMPLES TYPE	SAMPLES RECOVERY	MOISTURE	GRAPHIC LOG C Z S G	LITHOLOGIC DESCRIPTION (particle size distribution, sorting, mineralogy, roundness, color, reaction to HCl, etc.)	COLOR MUNSELL CODE	COLOR NAME	HCl REACTION	CASING LOG 6" 3" 0 3" 6"	DRILLING AND COMPLETION COMMENTS (drilling rate, down time, blow counts, water level, drill fluid, casing, seals, etc.)
0.0											Ground Surface
0.5											Hole is located near H2.
1.0											With Jason Ritter. See Todd notes in Lab.
1.5											book.
2.0											
2.5											
3.0											
3.5											
4.0											
4.5											
5.0											
5.5											
6.0											
6.5											
7.0											
7.5						Not Sampled.					
8.0											
8.5											
9.0											
9.5											2" ID Borehole.
10.0											
10.5											
11.0											
11.5											
12.0											
12.5											
13.0											
13.5											
14.0											
14.5											Sampler bound at 15.5 ft (recovered sluff).
15.0											Reran sampler, very fine material.
15.5	11:00	WL				*SAND. Coarse sand and pea gravel, w/ fine*					Broke tube's threads.
16.0											
16.5		WL	90%			*SAND. Fine.*					Grout at top.
17.0											
17.5		WL	100%	D		*SAND. Fine to medium.*					
18.0											
18.5		WL	100%	W		*SAND. Fine to medium.*					
19.0											
19.5		WL	100%			*SAND. Coarse w/ fines, salt & pepper textur*					LBNL Sample (80%)
20.0											
20.5		WL	100%	M-W		*SAND. Salt & pepper texture. Very moist.*					
21.0											
21.5		WL	100%	M		*SAND. Fine to medium 1/2 moist (upper)*					
22.0				D?							
22.5		WL	100%			*SAND. Fine to medium.*					
23.0											
23.5		WL	100%	W		*SAND. Medium. Salt & pepper texture. Very*					
24.0											
24.5		WL	100%			*SAND. 1/2 Salt & pepper, 1/2 fine sand.*					
25.0											
25.5		WL	100%			*SAND. Fine sand over medium salt & peppe*					
26.0											
26.5		WL	100%			*SAND. Fine.*					LBNL Sample (80%).
27.0											
27.5		WL	100%			*SAND. Fine.*					
28.0											
28.5		WL	100%			*SAND. Fine, w/salt & pepper texture.*					
29.0											
29.5		WL	100%			*SAND. Fine.*					LBNL Sample.
30.0											
30.5		WL	100%			*SAND. Fine.*					
31.0											
31.5		WL	100%			*SAND. Fine*					

35.0											Neet Cement grout.
35.5		WL	100%			*SAND. Medium.*					
36.0											
36.5		WL	100%	M-W		*SAND. Fine to coarse. Very moist.*					LBNL Sample (80%)
37.0											
37.5		WL	100%	M-W		*SAND. Coarse w/clay.*					LBNL Sample (80%)
38.0											
38.5		WL	100%	M-W		*SAND. Medium to coarse.*					
39.0											
39.5		WL	100%	D		*SAND. Medium.*					
40.0											
40.5		WL	100%			*SAND. Fine to medium.*					
41.0											
41.5		WL	90%			*SAND. Fine to medium, subangular.*					
42.0											
42.5		WL	100%			*SAND. Medium, salt & pepper.*					
43.0											
43.5		WL	100%			*SAND. Fine, salt & pepper.*					
44.0											
44.5		WL	80%			*SAND. Fine, salt & pepper.*					LBNL Sample.
45.0											
45.5		WL	100%			*SAND. Fine to medium, salt & pepper.*					
46.0											
46.5		WL	100%			*SAND. Fine to medium, salt & pepper, suba*					
47.0											
47.5		WL	100%			*SAND. Fine.*					
48.0											
48.5		WL	100%			*SAND. Fine to medium, subangular.*					
49.0											
49.5		WL	100%			*SAND. Fine.*					LBNL Sample.
50.0											
50.5		WL	100%			*SAND. Fine to medium.*					
51.0											
51.5		WL	100%			*SAND. Fine, salt & pepper.*					
52.0											
52.5		WL	100%			*SAND. Fine sand w/fines.*					
53.0											
53.5		WL	100%			*SAND. Fine to medium, subangular.*					
54.0											
54.5	13:30	WL	100%			*SAND. Fine to medium, subangular.*					LBNL Sample.
55.0											
55.5											
56.0											
56.5											
57.0											
57.5											
58.0											
58.5											
59.0											Note: *Lithologic description based on field examination of chip sample* as well as later examination in the laboratory
59.5											
60.0											

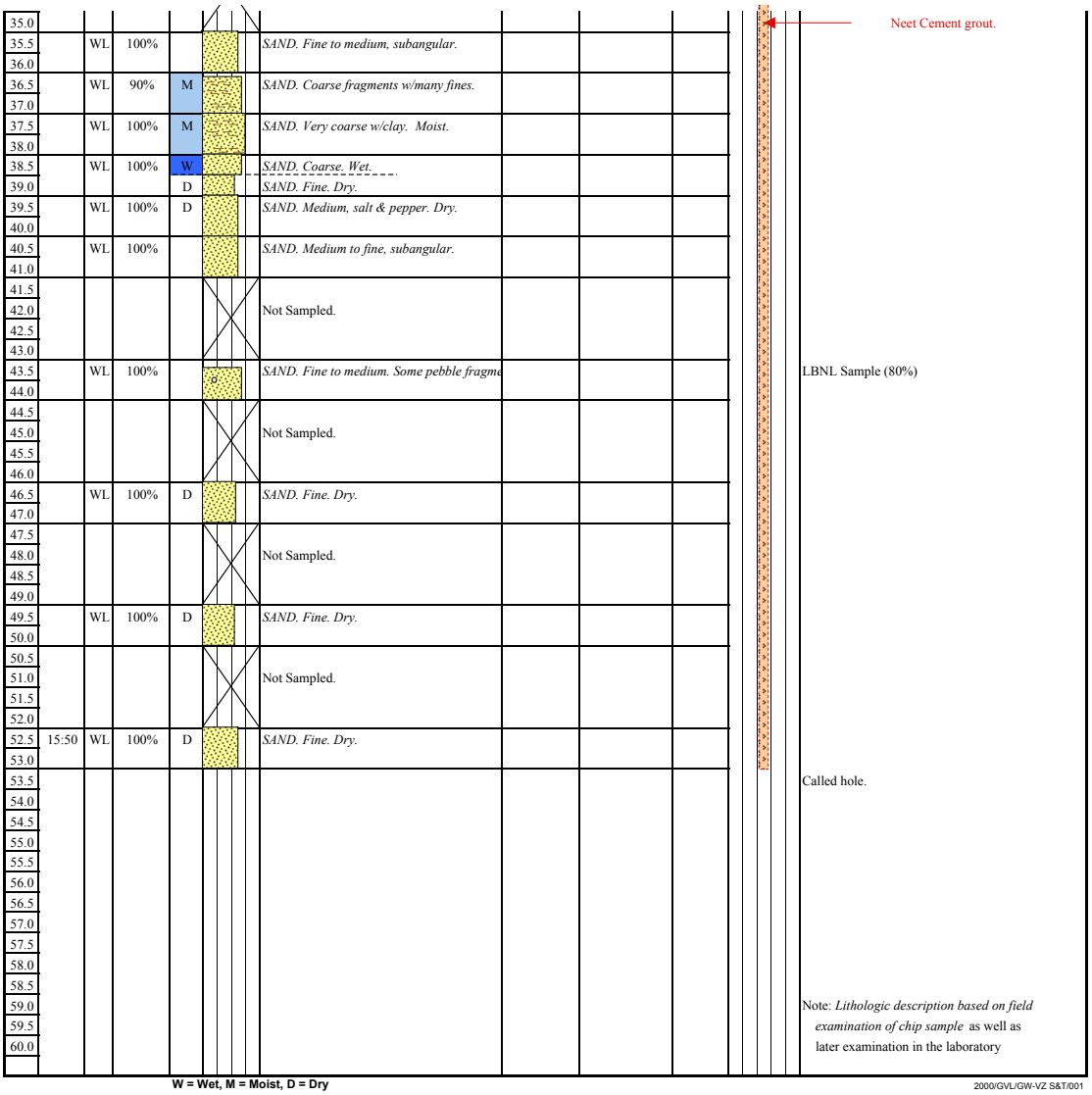
W = Wet, M = Moist, D = Dry

2000/GVL/GW-VZ S&T/001

Pacific Northwest National Laboratory	**BOREHOLE LOG**	Boring/Well No: WL-4 (S-8)	Depth: 0-53'	Date: 3/23/2001	Sheet: 1 of 1
		Location: Sisson & Lu Site, 200 East Area	Project: VZTF Study		

Logged by: T. G. Caldwell (Print / Sign)		Drilling Contractor: Applied Research Assoc.	
Reviewed by: (Print / Sign)	Date:	Driller: Willi Dickerson / John Mayhew	
Lithologic Class. Scheme: Folk/Wentworth	Procedure: PNL-MA-567, DO-1	Rev: 1	Rig/Method: CPT with Wire Line Sampler
Steel Tape/E-Tape: NA / NA	Field Indicator Equip. 1): NA	2): NA	Depth Control Point: Ground Surface

DEPTH (Ft.)	TIME	SAMPLES TYPE	SAMPLES RECOVERY	MOISTURE	GRAPHIC LOG C Z S G	LITHOLOGIC DESCRIPTION (particle size distribution, sorting, mineralogy, roundness, color, reaction to HCl, etc.)	COLOR MUNSELL CODE	COLOR NAME	HCl REACTION	CASING LOG 6" 3" 0 3" 6"	DRILLING AND COMPLETION COMMENTS (drilling rate, down time, blow counts, water level, drill fluid, casing, seals, etc.)
0.0											Ground Surface
0.5											Hole is located near H8.
1.0											With Jason Ritter. See Todd notes in Lab.
1.5											book.
2.0											
2.5											
3.0											
3.5											
4.0											
4.5											
5.0											
5.5											
6.0											
6.5											
7.0											
7.5						Not Sampled.					
8.0											
8.5											
9.0											
9.5											2" ID Borehole.
10.0											
10.5											
11.0											
11.5											
12.0											
12.5											
13.0											
13.5											
14.0											
14.5											
15.0											
15.5	14:30	WL	90%			*SAND. Fine.*					
16.0											
16.5		WL	100%			*SAND. Fine to medium.*					
17.0											
17.5		WL	100%			*SAND. Fine.*					
18.0											
18.5		WL	80%			*SAND. Fine to medium.*					
19.0											
19.5		WL	100%			*SAND. Medium to fine w/salt & pepper textu*					
20.0											
20.5		WL	100%	M		*SAND. Medium. Moist.*					LBNL Sample (80%).
21.0											
21.5		WL	80%			*SAND. Fine to medium.*					
22.0											
22.5		WL	80%	D		*SAND. Medium, subangular.*					
23.0											
23.5		WL	90%			*SAND. Fine to medium.*					
24.0											
24.5		WL	90%			*SAND. Fine.*					
25.0											
25.5											
26.0											
26.5						Not Sampled.					
27.0											
27.5											
28.0											
28.5		WL	75%			*SAND. Fine.*					
29.0											
29.5											LBNL Sample (80%)
30.0											
30.5						Not Sampled.					
31.0											
31.5											


35.0
35.5
36.0
36.5
37.0
37.5
38.0
38.5
39.0
39.5
40.0
40.5
41.0
41.5
42.0
42.5
43.0
43.5
44.0
44.5
45.0
45.5
46.0
46.5
47.0
47.5
48.0
48.5
49.0
49.5
50.0
50.5
51.0
51.5
52.0
52.5
53.0
53.5
54.0
54.5
55.0
55.5
56.0
56.5
57.0
57.5
58.0
58.5
59.0
59.5
60.0
WL 100%
SAND. Fine to medium, subangular.
WL 90%
M
SAND. Coarse fragments w/many fines.
WL 100%
M
SAND. Very coarse w/clay. Moist.
WL 100%
W
SAND. Coarse. Wet.
D
SAND. Fine. Dry.
WL 100%
D
SAND. Medium, salt & pepper. Dry.
WL 100%
SAND. Medium to fine, subangular.
Not Sampled.
WL 100%
SAND. Fine to medium. Some pebble fragme
Not Sampled.
WL 100%
D
SAND. Fine. Dry.
Not Sampled.
WL 100%
D
SAND. Fine. Dry.
Not Sampled.
15:50
WL 100%
D
SAND. Fine. Dry.
Neet Cement grout.
LBNL Sample (80%)
Called hole.
Note: Lithologic description based on field examination of chip sample as well as later examination in the laboratory
W = Wet, M = Moist, D = Dry
2000/GVL/GW-VZ S&T/001

Pacific Northwest National Laboratory	**BOREHOLE LOG**	Boring/Well No WL-5 (S-9)	Depth 0-49'	Date 4/16/2001	Sheet
		Location Sisson & Lu Site, 200 East Area	Project VZTF Study		1 of 1

Logged by T. G. Caldwell (In the field) / G. V. Last (In the lab.) (Print / Sign / Print / Sign)
Drilling Contractor Applied Research Assoc.
Reviewed by (Print / Sign) **Date**
Driller Wes Bratton/ Willi Dickerson
Lithologic Class. Scheme Folk/Wentworth **Procedure** PNL-MA-567, DO-1 **Rev** 1
Rig/Method CPT with Wire Line Sampler
Steel Tape/E-Tape NA / NA **Field Indicator Equip.** 1) NA 2) NA
Depth Control Point Ground Surface

DEPTH (Ft.)	TIME	SAMPLES TYPE	SAMPLES RECOVERY	MOISTURE	GRAPHIC LOG C Z S G	LITHOLOGIC DESCRIPTION (particle size distribution, sorting, mineralogy, roundness, color, reaction to HCl, etc.)	DRY (MOIST) COLOR MUNSELL CODE	DRY (MOIST) COLOR NAME	HCl REACTION	CASING LOG 6" 3" 0 3" 6"	DRILLING AND COMPLETION COMMENTS (drilling rate, down time, blow counts, water level, drill fluid, casing, seals, etc.)
0.0											Ground Surface
0.5											Todd Caldwell and Jason Ritter collected
1.0											and described the samples in the field.
1.5											Refer to Todd's notes in lab. book.
2.0											Hole is located near S-5.
2.5											
3.0											
3.5											
4.0											
4.5											
5.0											
5.5											
6.0											
6.5											
7.0											
7.5						Not Sampled.					
8.0											
8.5											
9.0											
9.5											2" ID Borehole.
10.0											
10.5											
11.0											
11.5											
12.0											
12.5											
13.0											
13.5											
14.0											
14.5											
15.0	8:27										
15.5		WL	75%			*SAND. Fine to medium (salt and pepper).*					
16.0											
16.5		WL	80%			*SAND. Fine (some salt and pepper).*	2.5Y7/1	light gray	weak to strong		
17.0											
17.5		WL	90%			*SAND. Fine (some salt and pepper).*					
18.0											
18.5		WL	100%	*M*		*SAND. Fine to medium.*					
19.0											
19.5		WL	100%	*M-W*		*SAND. Fine to coarse.* Mostly medium to coarse sand.	2.5Y6/2	light brownish gray	weak		
20.0											
20.5		WL	100%	*M-W*		*SAND. Fine to very coarse.*					
21.0											
21.5		WL	100%	*M*		*SAND. Fine to coarse.* Poorly sorted.	2.5Y6/2	light brownish gray	weak		
22.0				(W)							
22.5		WL	100%	*M*		*SAND. Fine to medium (salt and pepper).*	2.5Y6/2	light brownish gray	weak to strong		
23.0											
23.5		WL	100%	*D-M*		*SAND. Medium to coarse.* Mostly medium, some coarse	2.5Y6/2	light brownish gray	strong		
24.0											
24.5		WL	90%	*D-M*		*SAND. Medium to coarse (salt and pepper)*					
25.0											
25.5		WL	90%	*D-M*		*SAND. Medium (less salt and pepper)*					
26.0											
26.5		WL	100%	*M*		*SAND. Fine to medium.*	2.5Y6/1	gray	weak to strong		
27.0											
27.5		WL	100%	*D-M*		*SAND. Fine to medium.*					
28.0											
28.5		WL	100%	*M-W*		*SAND. Fine to coarse.*					
29.0											
29.5		WL	100%	*D-M*		*SAND. Fine to medium.*					
30.0											
30.5		WL	100%	*D-M*		*SAND. Fine to medium.* Mostly medium sand.	2.5Y7/1	light gray	weak		
31.0											
31.5		WL	100%	*D*		*SAND. Fine to medium (some salt and pepp*					

Pacific Northwest National Laboratory	**BOREHOLE LOG**	Boring/Well No WL-5 (S-9)	Depth 0-49'	Date 4/16/2001	Sheet
		Location Sisson & Lu Site, 200 East Area	Project VZTF Study		1 of 1

Logged by T. G. Caldwell (In the field) / G. V. Last (In the lab.) **Drilling Contractor** Applied Research Assoc.

Reviewed by _____ **Date** _____ **Driller** Wes Bratton/ Willi Dickerson

Lithologic Class. Scheme Folk/Wentworth **Procedure** PNL-MA-567, DO-1 **Rev** 1 **Rig/Method** CPT with Wire Line Sampler

Steel Tape/E-Tape NA / NA **Field Indicator Equip.** 1) NA 2) NA **Depth Control Point** Ground Surface

DEPTH (Ft.)	TIME	SAMPLES TYPE	SAMPLES RECOVERY	MOISTURE	GRAPHIC LOG C	Z	S	G	LITHOLOGIC DESCRIPTION (particle size distribution, sorting, mineralogy, roundness, color, reaction to HCl, etc.)	DRY (MOIST) COLOR MUNSELL CODE	DRY (MOIST) COLOR NAME	HCl REACTION	CASING LOG 6"	3"	0	3"	6"	DRILLING AND COMPLETION COMMENTS (drilling rate, down time, blow counts, water level, drill fluid, casing, seals, etc.)
35.0																		
35.5		WL	100%	D					*SAND. Medium, some coarse.*									Neet cement grout.
36.0																		
36.5		WL	100%	D					*SAND. Medium, some coarse.* Poorly sorted coarse to fine sand	2.5Y7/2	light gray	weak						
37.0																		
37.5		WL	100%	D-M					*SAND. Medium, some coarse.*									
38.0																		
38.5		WL	100%	M-W					*SAND. Medium w/clay* Coarse to fine sand, some silt	2.5Y6/2	light brownish gray	weak						
39.0																		
39.5		WL	100%	D					*SAND. Fine to medium.*									
40.0																		
40.5		WL	100%	D					*SAND. Fine to medium.*									
41.0																		
41.5		WL	100%	M					*SAND. Medium, some coarse.* Mostly M-F sand, some VF pebble.	2.5Y7/1	light gray	weak						
42.0																		
42.5		WL	100%	D					*SAND. Fine to medium.*									
43.0																		
43.5		WL	100%	D					*SAND. Medium, some coarse.* Some VC sand to VF pebble.	2.5Y7/1	light gray	weak						
44.0																		
44.5		WL		D					*SAND. Medium, some coarse.*									
45.0																		
45.5		WL	80%	D					*SAND. Fine to medium.*									
46.0																		
46.5		WL	100%	D					*SAND. Fine to medium (some salt and pepp* Some VC sand to VF pebble.	2.5Y7/1	light gray	weak						
47.0																		
47.5		WL	40%						*SAND. Medium, some coarse (salt and pepp*									
48.0																		
48.5		WL	100%						*SAND. Fine to medium (salt and pepper)* Some VF pebble. Pinkish color on some	2.5Y7/1	light gray	weak						
49.0																		
49.5	9:50																	Dirt in hole. End.
50.0																		
50.5																		
51.0																		
51.5																		
52.0																		
52.5																		
53.0																		
53.5																		
54.0																		
54.5																		
55.0																		
55.5																		
56.0																		
56.5																		
57.0																		
57.5																		
58.0																		Note: *Lithologic description based on field examination of chip sample* as well as later examination in the laboratory. H_2S odor observed after applying HCl - likely due to presence of sodium thiosulfate
58.5																		
59.0																		
59.5																		
60.0																		

W = Wet, M = Moist, D = Dry

2000/GVL/GW-VZ S&T/001

Pacific Northwest National Laboratory	**BOREHOLE LOG**	Boring/Well No WL-6	Depth 0-55'	Date 4/16/2001	Sheet 1 of 1
		Location Sisson & Lu Site, 200 East Area	Project VZTF Study		

Logged by T. G. Caldwell (In the field) / G. V. Last (In the lab.)		**Drilling Contractor** Applied Research Assoc.	
Reviewed by	**Date**	**Driller** Wes Bratton/ Willi Dickerson	
Lithologic Class. Scheme Folk/Wentworth	**Procedure** PNL-MA-567, DO-1	**Rev** 1	**Rig/Method** CPT with Wire Line Sampler
Steel Tape/E-Tape NA / NA **Field Indicator Equip.** 1) NA 2) NA			**Depth Control Point** Ground Surface

DEPTH (Ft.)	TIME	SAMPLES TYPE	SAMPLES RECOVERY	MOISTURE	GRAPHIC LOG C Z S G	LITHOLOGIC DESCRIPTION (particle size distribution, sorting, mineralogy, roundness, color, reaction to HCl, etc.)	DRY (MOIST) COLOR MUNSELL CODE	DRY (MOIST) COLOR NAME	HCl REACTION	CASING LOG 6" 3" 0 3" 6"	DRILLING AND COMPLETION COMMENTS (drilling rate, down time, blow counts, water level, drill fluid, casing, seals, etc.)
0.0											Ground Surface
0.5											Todd Caldwell and Jason Ritter collected
1.0											and described the samples in the field.
1.5											Refer to Todd's notes in lab. Book.
2.0											
2.5											
3.0											
3.5											
4.0											
4.5											
5.0											
5.5											
6.0											
6.5											
7.0											
7.5						Not Sampled.					
8.0											
8.5											
9.0											
9.5											2" ID Borehole.
10.0											
10.5											
11.0											
11.5											
12.0											
12.5											
13.0											
13.5											
14.0											
14.5											
15.0											
15.5	10:41	WL	30%								Grouty, not a good sample, pulling pipe.
16.0											
16.5	11:00										No good.
17.0											
17.5											Skipped.
18.0											
18.5		WL	70%	D		*SAND. Medium.* Very poorly sorted with	10YR7/1	light gray	weak to		3rd run.
19.0						lots of very fine sand to silt, and some coa			strong		
19.5		WL	100%	M-W		*SAND. Medium to coarse (salt and pepper).*	2.5Y7/2	light gray	weak		
20.0						Some very fine sand to silt.					
20.5		WL	100%	M-W		*SAND. Medium to coarse (salt and pepper).*	2.5Y6/2	light brownish gray	weak		
21.0						Fairly well sorted, very little silt.					
21.5		WL	100%	M		*SAND. Medium, some coarse (salt and pepp*					
22.0											
22.5		WL	100%	M		*SAND. Medium to coarse.*	2.5Y6/2	light brownish gray	weak		
23.0						Mostly medium, very little coarse, some fi					
23.5		WL	100%	M		*SAND. Medium to coarse.*					
24.0											
24.5		WL	100%	D		*SAND. Medium to fine (little salt and pepper*	2.5Y6/2	light brownish gray	weak		
25.0											
25.5		WL	100%	D		*SAND. Medium to fine (little salt and pepper*					
26.0											
26.5		WL	100%	D		*SAND. Fine, some medium.*	2.5Y7/1	light gray	weak to strong		
27.0											
27.5		WL	100%	D		*SAND. Medium, some fine and coarse.*					
28.0											
28.5		WL	100%	D		*SAND. Fine to medium (salt and pepper)*					
29.0											
29.5		WL	100%	D		*SAND. Fine to medium (salt and pepper)*	2.5Y6/2	light brownish gray	weak		
30.0						Poorly sorted, some very fine sand to silt.					
30.5		WL	100%	D-M		*SAND. Fine.*					Neet cement grout.
31.0											
31.5		WL	100%	D-M		*SAND. Fine*	2.5Y6/2	light brownish	none		

35.0									
35.5		WL	100%	*M*		*SAND. Fine with coarse fragments.*	2.5Y6/2	light brownish gray	weak
36.0						Poorly sorted. Some very fine sand to silt			
36.5		WL	100%	*M*		*SAND. Medium with coarse fragments.*	2.5Y6/2	light brownish gray	weak
37.0						Poorly sorted. Some silt in clumps.			
37.5		WL	100%	*M*		*SAND. Coarse w/clay. Very heterogenious.*			
38.0									
38.5		WL	100%	*D*		*SAND. Coarse to medium (salt & pepper)*	2.5Y7/1	light gray	weak
39.0						Mostly medium sand some fine and a little			
39.5		WL	100%	*D*		*SAND. Coarse to medium (salt & pepper)*			
40.0									
40.5		WL	100%	*D*		*SAND. Fine to medium (salt & pepper)*			
41.0									
41.5		WL	100%	*D*		*SAND. Medium, coarse frags.*	10YR7/1	light gray	weak
42.0						Mostly M., some C. and some F. to VF. sa			
42.5		WL	100%	*D*		*SAND. Medium, coarse frags.*			
43.0									
43.5		WL	100%	*D*		*SAND. Medium (salt & pepper)*			
44.0									
44.5		WL	100%	*M*		*SAND. Medium, lots of basalt (salt & pepper*	2.5Y7/1	light gray	weak to none
45.0						Some fine and coarse sand			
45.5		WL	100%	*D*		*SAND. Medium to fine.*			
46.0									
46.5		WL	100%			*SAND. Medium (some salt and pepper)*	2.5Y7/1	light gray	weak
47.0						Some fine sand, very little coarse.			
47.5		WL	100%			*SAND. Medium to coarse. Large angular gr*	2.5Y7/1	light gray	weak to none
48.0						Some F-VF sand and some VF pebbles (an			
48.5		WL	100%	*D*		*SAND. Medium to coarse.*			
49.0									
49.5		WL	100%			*SAND. Medium (salt & pepper).*			
50.0									
50.5		WL	100%			*SAND. Medium to fine.*	10YR7/1	light gray	none
51.0						Mostly medium sand			
51.5		WL	100%			*SAND. Medium to fine.*			
52.0									
52.5		WL	100%	*D*		*SAND. Fine to medium.*	10YR7/1	light gray	weak
53.0						Mostly fine sand			
53.5		WL	100%	*D*		*SAND. Fine to medium.*			
54.0									
54.5	13:03	WL	100%	*D*		*SAND. Fine to medium.*			
55.0									
55.5									
56.0									
56.5									
57.0									
57.5									
58.0									
58.5									
59.0									
59.5									
60.0									

Note: *Lithologic description based on field examination of chip sample* as well as later examination in the laboratory. H_2S odor observed after applying HCl - likely tracer.

W = Wet, M = Moist, D = Dry

2000/GVL/GW-VZ S&T/001

Pacific Northwest National Laboratory	**BOREHOLE LOG**	Boring/Well No: WL-7	Depth: 0-52'	Date: 5/9/2001	Sheet: 1 of 1
		Location: Sisson & Lu Site, 200 East Area	Project: VZTF Study		

Logged by T. G. Caldwell (In the field) / G. V. Last (In the lab.)			**Drilling Contractor** Applied Research Assoc.
Reviewed by	**Date**		**Driller** Wes Bratton / John Mayhew
Lithologic Class. Scheme Folk/Wentworth	**Procedure** PNL-MA-567, DO-1	**Rev** 1	**Rig/Method** CPT with Wire Line Sampler
Steel Tape/E-Tape NA / NA **Field Indicator Equip.** 1) NA 2) NA			**Depth Control Point** Ground Surface

DEPTH (ft)	TIME	SAMPLES TYPE	SAMPLES RECOVERY	MOISTURE	GRAPHIC LOG C Z S G	LITHOLOGIC DESCRIPTION (particle size distribution, sorting, mineralogy, roundness, color, reaction to HCl, etc.)	COLOR MUNSELL CODE	COLOR NAME	HCl REACTION	CASING LOG 6" 3" 0 3" 6"	DRILLING AND COMPLETION COMMENTS (drilling rate, down time, blow counts, water level, drill fluid, casing, seals, etc.)
0.0											Ground Surface
0.5											Todd Caldwell collected and described the samples in the field. Refer to his notes in lab. book.
1.0											
1.5											
2.0											Hole is located approximately 20 cm due south of Well #101 (G3).
2.5											
3.0											
3.5											
4.0											
4.5											
5.0											
5.5											
6.0											
6.5											
7.0											
7.5						Not Sampled.					
8.0											
8.5											
9.0											
9.5											2" ID Borehole.
10.0											
10.5											
11.0											
11.5											
12.0											
12.5											
13.0											
13.5											
14.0											
14.5											
15.0											
15.5	15:10		80%			SAND. Fine-medium, some fines, some salt	2.5Y7/1	light gray	strong		Possible slough. Had to pull rods at 14' and redo.
16.0						texture.					
16.5			80%	D		*SAND. Fine-medium, some salt&pepper.*	2.5Y7/1	light gray	strong		
17.0											
17.5			90%	D		*SAND. Fine-medium, some salt&pepper.*	2.5Y7/1	light gray	strong		
18.0											
18.5			100%	W		*SAND. Fine w/coarse, subangular, very wet.*	2.5Y6/1	gray	weak-strong		
19.0											
19.5			100%	W		*SAND. Coarse, subangular, salt/pep. Very w*	2.5Y6/2	light brownish gray	weak		
20.0						*with fines.*					
20.5			100%	W		*SAND. Coarse, subangular, salt/pep. Very w*	2.5Y6/2	light brownish gray	weak		
21.0						*with fines.*					
21.5			80%	M-W		*SAND. Medium, some coarse fragments. Les*	2.5Y6/2	light brownish gray	weak-strong		
22.0											
22.5			90%	M-W		*SAND. Medium-coarse, salt&pepper, less w*	2.5Y6/2	light brownish gray	weak-strong		
23.0											
23.5			100%	M-W		*SAND. Medium-coarse, salt&pepper, less w*	2.5Y6/2	light brownish gray	weak-strong		
24.0											
24.5			100%	M		*SAND. Medium, some coarse, less salt&pep*	2.5Y6/2	light brownish gray	weak-strong		
25.0											
25.5			100%	M-D		*SAND. Medium, some quartz fragments, less*	2.5Y6/2	light brownish gray	weak		
26.0											
26.5			100%			*SAND. Medium-fine.*	2.5Y6/2	light brownish gray	weak-strong		
27.0											
27.5			100%			*SAND. Medium-fine.*	2.5Y6/1	gray	weak		
28.0											
28.5			100%			*SAND. Medium-fine.*	2.5Y6/1	gray	weak		
29.0											
29.5			100%	M-D		*SAND. Fine-medium, less damp.*	2.5Y6/1 to 2.5Y6/2	gray tolight brownish gray	weak		
30.0											
30.5			100%			*SAND. Fine-medium.*	2.5Y6/2	light brownish gray	weak-none		
31.0											
31.5			100%	W		*SAND. Fine, wet*	2.5Y6/2	light brownish	weak		

35.0								gray		
35.5			100%			SAND. Coarse. Some fines.	2.5Y6/2	light brownish gray	weak	
36.0										
36.5			70%			SAND. Fine to medium. Some fines.	2.5Y6/2	light brownish gray	weak-strong	
37.0										
37.5	16:15		100%			SAND. Coarse to fine. Some fines.	2.5Y6/2	light brownish gray	weak-strong	
38.0										
38.5			100%	D-M		*SAND. Fine-medium, much less water* Some coarse sand.	2.5Y6/2	light brownish gray	weak-strong	
39.0										
39.5			100%	D		*SAND. Fine-medium, salt&pepper. Very dry*	2.5Y7/1	light gray	weak-strong	
40.0										
40.5			100%	D		*SAND. Fine-medium, salt&pepper. Very dry*	2.5Y6/2	light brownish gray	weak-strong	
41.0										
41.5			100%	D		*SAND. Medium-fine, salt&pepper. Dry.* Coarse to fine sand.	2.5Y6/2	light brownish gray	weak	
42.0										
42.5			60%			*SAND. Medium, salt&pepper.* Coarse to fine sand.	2.5Y6/2	light brownish gray	weak	
43.0										
43.5			70%			*SAND. Medium-fine, lots of quartz (white m* Medium to fine sand.	2.5Y6/2	light brownish gray	weak	
44.0										
44.5			0%							No recovery, sample fell out.
45.0										
45.5			100%			*SAND. Medium* (to fine), *with some large fr*	2.5Y6/2	light brownish gray	none.	Sample may contain some slough from previous sample.
46.0										
46.5			50%			*SAND, Fine-medium, salt with some pepper.*	2.5Y7/1	light gray	weak	
47.0										
47.5			0%							No sample, chamber unlocking.
48.0										
48.5			80%			*SAND. Fine-medium, some rounded pebbles*				
49.0										
49.5			100%			*SAND. Fine-medium.*	2.5Y7/1	light gray	weak	
50.0										
50.5			0%							No sample, latch problems again.
51.0										
51.5			50%			*SAND. Fine-medium.*	2.5Y7/1	light gray	weak	Slough from above.
52.0										
52.5			40%			*SAND. Fine.*	2.5Y7/2	light gray	weak	
53.0										
53.5	17:05									End hole (sampler jammed up)
54.0										
54.5										
55.0										
55.5										
56.0										
56.5										
57.0										
57.5										
58.0										Note: *Lithologic description based on field examination of chip sample* as well as later examination in the laboratory. H_2S odor observed after applying HCl - likely tracer.
58.5										
59.0										
59.5										
60.0										

Neet Cement grout.

W = Wet, M = Moist, D = Dry

2000/GVL/GW-VZ S&T/001

Pacific Northwest National Laboratory	**BOREHOLE LOG**	Boring/Well No: WL-8	Depth: 0-53.7'	Date: 5/10/2001	Sheet: 1 of 1
		Location: Sisson & Lu Site, 200 East Area	Project: VZTF Study		

Logged by G. V. Last (Print / Sign)			**Drilling Contractor** Applied Research Assoc.
Reviewed by (Print / Sign)	**Date**		**Driller** Wes Bratton / John Mayhew
Lithologic Class. Scheme Folk/Wentworth	**Procedure** PNL-MA-567, DO-1	**Rev** 1	**Rig/Method** CPT with Wire Line Sampler
Steel Tape/E-Tape NA / NA	**Field Indicator Equip.** 1) NA	2) NA	**Depth Control Point** Ground Surface

DEPTH (ft)	TIME	SAMPLES TYPE	SAMPLES RECOVERY	MOISTURE	GRAPHIC LOG C Z S G	LITHOLOGIC DESCRIPTION (particle size distribution, sorting, mineralogy, roundness, color, reaction to HCl, etc.)	COLOR MUNSELL CODE	COLOR NAME	HCl REACTION	CASING LOG 6" 3" 0 3" 6"	DRILLING AND COMPLETION COMMENTS (drilling rate, down time, blow counts, water level, drill fluid, casing, seals, etc.)
0.0											Ground Surface
0.5	9:06										Initiate direct push, using dummy tip.
1.0											Hole location is 1 m SW of G-5.
1.5											Refer also to Todd Caldwell's notes.
2.0											
2.5											
3.0											
3.5											
4.0											
4.5											
5.0											
5.5											
6.0											
6.5											
7.0											
7.5						Not Sampled.					
8.0											
8.5											
9.0											
9.5											2" ID Borehole.
10.0											
10.5											
11.0											
11.5											
12.0											
12.5											
13.0											
13.5											
14.0											
14.5											
15.0	9:11										Replace dummy tip with wireline sampler.
15.5	9:14	WL	80%	D		*SAND. Fine, with some silt to VF sand. Trac*	2.5Y7/1	light gray	strong		
16.0											
16.5		WL	90%	D		*SAND. Fine, with some silt to VF sand. Trac* to VC.	2.5Y7/2	light gray	strong		
17.0											
17.5		WL	90%	D		*SAND. Fine, with some silt to VF sand. Trac* to VC. Mostly medium sand, coarser than	2.5Y7/1	light gray	weak-strong		
18.0											
18.5	9:19	WL	60%	M		*SAND. A little coarser, less fines, more C. sa* Some VC sand.	2.5Y7/1	light gray	weak-strong		
19.0											
19.5	9:23	WL	100%	M-W		*SAND. Medium (coarser still). Wet layers.*	2.5Y7/2	light gray	strong		
20.0											
20.5	9:24	WL	100%	M-W		*SAND. Coarse to very coarse, laminated wit*	2.5Y7/2	light gray	strong		
21.0						*to very fine sand.*					
21.5	9:28	WL	100%	D-M		*SAND. Coarse to fine, laminated. Alternati*	2.5Y7/1	light gray	strong		
22.0						*dry to wet (wet layers).*					
22.5	9:30	WL	100%	D-M		*SAND. Coarse to med, with some fines, lami*	2.5Y7/2 to 6/2	light gray to lt brownish gray	weak		
23.0											
23.5	9:31	WL	80%	M-W		*SAND. Coarse to med. Laminated.*	2.5Y7/2 to 6/2	light gray to lt brownish gray	weak-strong		
24.0											
24.5		WL	100%	D-M		*SAND. Coarse to fine. Laminated.* Coarser w/less fines. Salt & pepper textur	2.5Y7/1	light gray	weak		
25.0											
25.5	9:36	WL	50%	D		*SAND. Coarse to fine. Poorly sorted, some f*	2.5Y7/2	light gray	weak		Sampler delatched.
26.0						*Probably laminated with perhaps some gr*					
26.5	9:40	WL	60%	D		*SAND. Coarse to fine. Poorly sorted, some f*	2.5Y7/1 to 7/2	light gray	weak		
27.0						*Probably laminated with perhaps some gr*					
27.5	9:42	WL	80%	D		*SAND. Coarse to fine. Poorly sorted, some f*	2.5Y7/2	light gray	weak-strong		
28.0						*Probably laminated with perhaps some gr*					
28.5	9:46	WL	50%	D-M		*SAND. Med. to fine. Better sorted. Laminate*	2.5Y7/2	light gray	weak		
29.0											
29.5	9:50	WL	80%	D-M		*SAND. Coarse to VF sand, with some fines.*	2.5Y7/2	light gray	weak-strong		
30.0						Mostly fine to medium sand.					
30.5	9:52	WL	80%	M		*SAND. Medium. Better sorted. Laminated.*	2.5Y7/2	light gray	weak		
31.0											
31.5	9:55	WL	90%	M		*SAND. Medium. Partially laminated*	2.5Y7/2	light gray	weak		

35.0						Some coarse sand.		gray			Neet Cement grout.
35.5	10:05	WL	90%	M-W		*SAND. Medium to fine, with string of VF sa*	2.5Y6/2	light brownish gray	weak-strong		
36.0						to silt. Some coarse sand.					
36.5	10:08	WL	40%	M-W		*SAND. Medium to fine. Some VF sand (from*	2.5Y6/2	light brownish gray	weak		
37.0						*stringers?), moist with clays & coarse.*					
37.5	10:10	WL	100%	M-W		*SAND. Medium, laminated with VF sand str*	2.5Y6/2	light brownish gray	weak		
38.0						(to silt).					
38.5	10:12	WL	100%	M-W		*SAND. Medium, better sorted, with some co*	2.5Y6/1	gray	weak		
39.0											
39.5	10:14	WL	80%	D		*SAND. Medium to fine.*	2.5Y7/1	light gray	weak-none		
40.0											
40.5	10:18	WL	80%	D-M		*SAND. Medium, better sorted. Some Coarse*	2.5Y7/1	light gray	weak		
41.0						*laminations.*					
41.5	10:20	WL	80%	M		*SAND. Coarse to fine.*	2.5Y7/1	light gray	weak		
42.0											
42.5	10:22	WL	80%	D-M		*SAND. Coarse to fine. Poorly sorted. (lamin*	2.5Y7/1	light gray	weak		
43.0											
43.5	10:25	WL	80%	D-M		*SAND. Medium to fine.*	2.5Y7/1	light gray	none		
44.0											
44.5	10:27	WL	100%	D-M		*SAND. Medium, with some coarse sand lam*	2.5Y7/1	light gray	weak-none		
45.0											
45.5	10:32	WL	100%	D-M		*SAND. Medium, some VC sand and VF pebb*	2.5Y7/1	light gray	weak-none		Sampler was slightly over driven (45-46.2')
46.0											
46.5	10:35	WL	40%	M		*SAND. Medium, clean, well sorted. Some V*	2.5Y6/1	gray	weak		
47.0						Mostly coarse to medium sand.					
47.5	10:38	WL	100%	D-M		*SAND. Medium.*	2.5Y7/1	light gray	weak		
48.0											
48.5	10:40	WL	90%	D		*SAND. Medium to fine. Poorly sorted, some*	2.5Y7/1	light gray	weak		
49.0						Some VC sand to VF pebble.					
49.5	10:43	WL	100%	D		*SAND. Medium to fine. More fines.*	2.5Y7/1	light gray	strong		
50.0						Some VC sand to VF pebble.					
50.5	10:46	WL	100%	D		*SAND. Coarse to medium. Few fines*	2.5Y7/1	light gray	weak-strong		
51.0											
51.5	10:48	WL	100%	D		*SAND. Medium. Some fines.*	2.5Y7/1	light gray	weak		
52.0											
52.5	10:50	WL	100%	D		*SAND. Medium. Some fines.*	2.5Y7/1	light gray	weak-none		
53.0											
53.5	10:52	WL	70%	D		*SAND. Medium. Some fines.*	2.5Y7/1	light gray	weak		Reached end of rod at 53.7'. Decided to stop.
54.0											
54.5	10:55										Tripped out of hole. Both well (WL-7 &
55.0											WL-8) filled & grouted to surface.
55.5											
56.0											
56.5											
57.0											
57.5											
58.0											Note: *Lithologic description based on field*
58.5											*examination of chip sample* as well as
59.0											later examination in the laboratory. H_2S
59.5											odor observed after applying HCl - likely
60.0											tracer.

W = Wet, M = Moist, D = Dry

2000/GVL/GW-VZ S&T/001

Pacific Northwest National Laboratory	**BOREHOLE LOG**	Boring/Well No: WL-9	Depth: 0-57'	Date: 5/23/2001	Sheet: 1 of 1
		Location: Sisson & Lu Site, 200 East Area	Project: VZTF Study		

Logged by: G. V. Last (Print / Sign) — Drilling Contractor: Applied Research Assoc.

Reviewed by: (Print / Sign) — Date: — Driller: Willi Dickerson / John Mayhew

Lithologic Class. Scheme: Folk/Wentworth — Procedure: PNL-MA-567, DO-1 — Rev: 1 — Rig/Method: CPT with Wire Line Sampler

Steel Tape/E-Tape: NA / NA — Field Indicator Equip. 1) NA 2) NA — Depth Control Point: Ground Surface

DEPTH (Ft.)	TIME	SAMPLES TYPE	SAMPLES RECOVERY	MOISTURE	GRAPHIC LOG C	Z	S	G	LITHOLOGIC DESCRIPTION (particle size distribution, sorting, mineralogy, roundness, color, reaction to HCl, etc.)	COLOR MUNSELL CODE	COLOR NAME	HCl REACTION	CASING LOG 6"	3"	0	3"	6"	DRILLING AND COMPLETION COMMENTS (drilling rate, down time, blow counts, water level, drill fluid, casing, seals, etc.)
0.0																		Ground Surface
0.5	9:43																	Initiated direct push, using dummy tip.
1.0																		No samples.
1.5																		Refer also to Todd Caldwell's notes.
2.0																		Hole location is between H6 and G5.
2.5																		
3.0																		
3.5																		
4.0																		
4.5																		
5.0																		
5.5																		
6.0																		
6.5																		
7.0																		
7.5									Not Sampled.									
8.0																		
8.5																		
9.0																		
9.5																		2" ID Borehole.
10.0																		
10.5																		
11.0																		
11.5																		
12.0																		
12.5																		
13.0																		
13.5																		
14.0																		
14.5																		
15.0	9:49																	Replace dummy tip with wireline sampler.
15.5	9:50	WL	80%	D					*SAND, Fine to coarse, some silt* Mostly fine sand.	2.5Y7/1	light gray	weak						Grout?
16.0																		
16.5	9:52	WL	90%	D-M					*SAND. Medium, less silt* Mostly fine to medium sand.	2.5Y7/1	light gray	weak-strong						
17.0																		
17.5	9:54	WL	100%	D-M					*SAND. Medium. (A little moisture)* Mostly medium to fine sand.	2.5Y7/1	light gray	weak						
18.0																		
18.5	9:58	WL	100%	D-M					*SAND. Medium w/fines. Some salt & pepper* (A little moister)	2.5Y7/1	light gray	weak-strong						
19.0																		
19.5	9:59	WL	100%	M					*SAND. Medium to coarse, laminated.*	2.5Y6/2	light brownish gray	strong						
20.0																		
20.5	10:01	WL	100%	W					*SAND. Medium to coarse.*	2.5Y5/2	brownish gray	strong						
21.0																		
21.5	10:08	WL	100%	W					*SAND. Coarse.*	2.5Y6/2	light brownish gray	weak-strong						
22.0																		
22.5	10:10	WL	80%	W-M					*SAND. Medium. With thin ~1.5" silt layer. dry laminations.* Some VC sand to VF pe	2.5Y6/2	light brownish gray	weak strong (silt						
23.0																		
23.5	10:14	WL	80%	M					*SAND. Medium to coarse. Some VF pebble*	2.5Y6/2	light brownish gray	weak						
24.0																		
24.5	10:18	WL	0%															No recovery.
25.0																		
25.5	10:23	WL	80%	D-M					*SAND. Medium.* Mostly medium to fine sand.	2.5Y7/1	light gray	weak - none						Perhaps some sluff from previous sample attempt.
26.0																		
26.5	10:26	WL	70%	D-M					*SAND. Medium. 1 VF pebble.* Mostly medium to fine sand.	2.5Y7/2	light gray	weak						
27.0																		
27.5	10:30	WL	100%	D-M					*SAND. Medium, some fines.* Mostly medium to fine sand.	2.5Y7/2	light gray	weak-strong						
28.0																		
28.5	10:32	WL	90%	D-M					*SAND. Medium, some fines.* Mostly medium to fine sand.	2.5Y7/2	light gray	weak						
29.0																		
29.5	10:37	WL	70%	D-M					*SAND. Medium, some fines.* Mostly medium to fine sand.	2.5Y7/2	light gray	none						
30.0																		
30.5	10:42	WL	100%	D-M					*SAND. Medium, some fines.*	2.5Y7/2	light gray	weak						
31.0																		
31.5	10:46	WL	100%	D-M					*SAND. Medium, fairly clean (few fines)*	2.5Y7/2	light gray	weak -						

35.0						*Laminated.*		gray			
35.5	10:57	WL	100%	M-W		*SAND. Coarse - medium. Laminated, with v*	2.5Y6/2	light brownish gray	weak		
36.0						*moisture.*					
36.5	10:59	WL	100%	M-W		*SAND. Coarse sand at top.*	2.5Y5/2	brownish gray	weak		
37.0				W		*SILT. Silt (mud) layer at bottom.*	2.5Y6/1	gray	weak		
37.5	11:02	WL	100%	W		*SAND/SILT. Laminated/stratified coarse sa*	2.5Y5/2	brownish gray	weak		
38.0											
38.5	11:10	WL	50%	M		*SAND. Medium, some coarse.*	2.5Y7/1	light gray	weak-strong		Some sample lost down hole.
39.0											
39.5	11:12	WL	100%	M		*SAND. Medium.*	2.5Y7/1	light gray	weak		
40.0											
40.5	11:15	WL	100%	M		*SAND. Medium.*	2.5Y7/1 - 2.5Y6/1	light gray to gray	weak		
41.0											
41.5	11:18	WL	100%	M-D		*SAND. Medium, more fines? Fine-coarse sa*	2.5Y6/2	light brownish gray	weak		
42.0											
42.5	11:19	WL	100%	M-D		*SAND. Fine to coarse.*	2.5Y6/2	light brownish gray	weak - none		
43.0											
43.5	11:22	WL	100%	M-D		*SAND. Fine to coarse, with thin C-VC sand*	2.5Y6/1	gray	weak		
44.0											
44.5	11:26	WL	100%	M-D		*SAND. Fine-coarse, some VC sand.*	2.5Y6/2	light brownish gray	weak		
45.0											
45.5	11:28	WL	70%	M-D		*SAND. Medium. Some laminations.*	2.5Y6/2	light brownish gray	weak		
46.0											
46.5	11:30	WL	80%	M-D		*SAND. Medium.*	2.5Y6/1-6/2	gray to lt. brownish gray	weak - none		
47.0											
47.5	11:34	WL	80%	M-D		*SAND. Medium - coarse.*	2.5Y7/1	light gray	weak		
48.0											
48.5	11:36	WL	80%	M-D		*SAND. Coarse-fine, some pebbles.*	2.5Y7/1	light gray	weak		
49.0											
49.5	11:38	WL	80%	M-D		*SAND. Coarse. 1 wetter lamination.*	2.5Y7/1	light gray	none		
50.0											
50.5	11:41	WL	90%	W		*SAND. Coarse - medium. Wetter.*	2.5Y6/2	light brownish gray	weak		
51.0											
51.5	11:43	WL	100%	M		*SAND. Medium. Less wet.*	2.5Y6/2	light brownish gray	weak		
52.0											
52.5	11:46	WL	100%	M		*SAND. Medium.*	2.5Y6/2	light brownish gray	weak		Very hard to remove sample.
53.0											
53.5	11:48	WL	100%	M		*SAND. Medium.*	2.5Y6/2	light brownish gray	weak		Very hard to remove sample.
54.0											
54.5	11:51	WL	100%	M-W		*SAND. Medium. Wet.*	2.5Y6/2	light brownish gray	weak		Very hard to remove sample.
55.0											
55.5	11:54	WL	100%	M		*SAND. Medium-Fine.*	2.5Y6/2	light brownish gray	weak-strong		Very hard to remove sample.
56.0											
56.5	11:58	WL	100%	M-D		*SAND. Medium-Fine.*					Easier to remove sample.
57.0											
57.5	12:00										Tripped out of hole.
58.0											
58.5											
59.0											
59.5											Note: *Lithologic description based on field examination of chip sample* as well as later examination in the laboratory
60.0											

Neet Cement grout.

W = Wet, M = Moist, D = Dry

2000/GVL/GW-VZ S&T/001

Pacific Northwest National Laboratory	**BOREHOLE LOG**	Boring/Well No: WL-10	Depth: 0-56'	Date: 5/23/2001	Sheet: 1 of 1
		Location: Sisson & Lu Site, 200 East Area	Project: VZTF Study		

Logged by G. V. Last (Print / Sign)			**Drilling Contractor** Applied Research Assoc.
Reviewed by (Print / Sign)		**Date**	**Driller** Willi Dickerson / John Mayhew
Lithologic Class. Scheme Folk/Wentworth	**Procedure** PNL-MA-567, DO-1	**Rev** 1	**Rig/Method** CPT with Wire Line Sampler
Steel Tape/E-Tape NA / NA	**Field Indicator Equip.** 1) NA 2) NA		**Depth Control Point** Ground Surface

DEPTH (Ft.)	TIME	SAMPLES TYPE	SAMPLES RECOVERY	MOISTURE	GRAPHIC LOG C Z S G	LITHOLOGIC DESCRIPTION (particle size distribution, sorting, mineralogy, roundness, color, reaction to HCl, etc.)	COLOR MUNSELL CODE	COLOR NAME	HCl REACTION	CASING LOG 6" 3" 0 3" 6"	DRILLING AND COMPLETION COMMENTS (drilling rate, down time, blow counts, water level, drill fluid, casing, seals, etc.)
0.0	13:31										Ground Surface
0.5	13:59										Initiated direct push, using dummy tip.
1.0											Hole located ~50-45cm from S-3. No
1.5											samples until 15'.
2.0											Hit bentonite at ~15.5'. Took sample
2.5											WL-10A 15-16'. Pulled out of hole and
3.0											moved backward 1.5 ft. Started new hole.
3.5											With Todd Caldwell, refer also to his notes.
4.0											
4.5											
5.0											
5.5											
6.0											
6.5											
7.0											
7.5											
8.0						Not Sampled.					
8.5											
9.0											
9.5											2" ID Borehole.
10.0											
10.5											
11.0											
11.5											
12.0											
12.5											
13.0											
13.5											
14.0											
14.5											
15.0	14:17										Replace dummy tip with wireline sampler.
15.5	14:18	WL	100%	D		*SAND. Fine.*	2.5Y7/2	light gray	weak		Grout?
16.0											
16.5	14:19	WL	100%	D		*SAND. Fine to medium.* Trace of VC sand to VF pebble.	2.5Y7/2	light gray	weak - none		
17.0											
17.5	14:22	WL	100%	D-M		*SAND. Fine to medium.*	2.5Y7/2	light gray	weak - strong		
18.0											
18.5	14:24	WL	100%	M		*SAND. Fine to medium, some coarser lamin* *Moist*	2.5Y7/2	light gray	weak		
19.0											
19.5	14:26	WL	100%	M-W		*SAND. Coarse to medium.*	2.5Y6/2	light brownish gray	weak-strong		
20.0											
20.5	14:28	WL	100%	M-W		*SAND. Coarse to medium.*	2.5Y6/2	light brownish gray	weak-strong		
21.0											
21.5	14:30	WL	100%	M		*SAND. Medium to fine.*	2.5Y6/2	light brownish gray	weak-strong		
22.0											
22.5	14:32	WL	100%	W		*SAND. Coarse to medium*	2.5Y6/2	light brownish gray	weak-strong		
23.0											
23.5	14:36	WL	100%	M-W		*SAND. Coarse*	2.5Y6/1	gray	weak		
24.0											
24.5	14:38	WL	100%	M-W		*SAND. Medium. Laminated.* *Less moisture.*	2.5Y6/1	gray	weak - none		
25.0											
25.5	14:40	WL	80%	M		*SAND. Coarse-medium. 1 coarser/wetter la*	2.5Y7/2	light gray	weak		
26.0											
26.5	14:43	WL	100%	M		*SAND. Medium.*	2.5Y7/2	light gray	weak		
27.0											
27.5	14:45	WL	100%	M		*SAND. Medium.*	2.5Y6/2	light brownish gray	weak-strong		
28.0											
28.5	14:47	WL	110%	M		*SAND. Medium.*	2.5Y6/2	light brownish gray	weak-strong		Over driven?
29.0											
29.5	14:49	WL	100%	M-W		*SAND. Medium.*	2.5Y5/2	brownish gray (moist)	weak-strong		
30.0											
30.5	14:53	WL	100%	M-W		*SAND. Medium.*	2.5Y5/2	brownish gray (moist)	weak-strong		
31.0											
31.5	14:56	WL	100%	M-W		*SAND. Medium*	2.5Y5/2	brownish gray	weak-		

35.0					*Several clay plugs.*		gray	strong		Neet Cement grout.
35.5	15:08	WL	100%	M	*SAND. Coarse. Laminated dry/wet. Silt plug*	2.5Y5/2	brownish gray (moist)	weak		
36.0				W						
36.5	15:11	WL	100%	W	*SILT. Silt at top (wet).*	2.5Y4/2	ark grayish brow (moist)	weak		
37.0				M-D	*SAND. Coarse sand beneath (moist-dry)*					
37.5	15:15	WL	50%	W	*SAND. Coarse, with thin silt lens (wet). Sat*	2.5Y5/2	brownish gray (moist)	weak		
38.0										
38.5	15:17	WL	100%	M-W	*SAND. Coarse.*	2.5Y5/2	brownish gray (moist)	weak		
39.0										
39.5	15:20	WL	100%	M-D	*SAND. Medium to fine.*	2.5Y6/1	gray	weak-strong		
40.0										
40.5	15:22	WL	100%	M-D	*SAND. Medium.*	2.5Y6/1	gray	weak		
41.0										
41.5	15:25	WL	50%	M	*SAND. Coarse to medium. Some yellowish/r*	2.5Y6/1	gray	weak		
42.0					*on some grains (secondary). Also seen in*					
42.5	15:28	WL	100%	M	*SAND. Fine to medium, with some VC sand*	2.5Y6/1	gray	weak		
43.0					*pebble. More basalt.*					
43.5	15:32	WL	70%	M	*SAND. Coarse to medium.*	2.5Y6/1	gray	weak - none		
44.0										
44.5	15:35	WL	80%	M-D	*SAND. Coarse to fine. Some VC sand.*	2.5Y6/1	gray	weak - none		
45.0										
45.5	15:37	WL	80%	M	*SAND. Medium.*	2.5Y6/1	gray	weak - none		
46.0										
46.5	15:39	WL	80%	M	*SAND. Coarse-fine.*	2.5Y6/1	gray	weak		
47.0										
47.5	15:41	WL	80%	M-D	*SAND. Coarse-fine with more fines?*	2.5Y6/1	gray	weak		
48.0										
48.5	15:44	WL	80%	M	*SAND. Coarse-medium.*	2.5Y6/1	gray	weak		
49.0										
49.5	15:47		0%							No recovery (latching problem).
50.0										
50.5	15:52	WL	80%	M-D	*SAND. Fine to medium. Some VC sand.*	2.5Y7/2	light gray	weak		Could be some slough in top of sample.
51.0										
51.5	15:55	WL	50%	M-D	*SAND. Fine to medium.*	2.5Y7/2	light gray	weak - none		
52.0										
52.5	15:57	WL	100%	M-D	*SAND. Medium.*	2.5Y7/2	light gray	weak		
53.0										
53.5	16:00	WL	100%	M-D	*SAND. Fine to medium.*	2.5Y7/2	light gray	weak-strong		
54.0										
54.5	16:02	WL	100%	M	*SAND. Fine to coarse. Some coarser wet lar*	2.5Y7/2	light gray	weak		
55.0										
55.5	16:04	WL	100%	M	*SAND. Medium.*	2.5Y6/2	light brownish gray	weak-strong		
56.0										
56.5	16:05									Tripped out of hole. Will grout holes tomorrow with neet cement, poured/ pumped down borehole.
57.0										
57.5										
58.0										
58.5										
59.0										
59.5										Note: *Lithologic description based on field examination of chip sample* as well as later examination in the laboratory
60.0										

W = Wet, M = Moist, D = Dry

2000/GVL/GW-VZ S&T/001

Pacific Northwest National Laboratory	**BOREHOLE LOG**	Boring/Well No WL-11	Depth 0-57'	Date 6/5/2001	Sheet 1 of 1
		Location Sisson & Lu Site, 200 East Area	Project VZTF Study		

Logged by G. V. Last (Print / Sign) _____ (Print / Sign)

Reviewed by _____ (Print / Sign) Date _____

Drilling Contractor Applied Research Assoc.

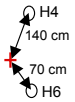
Driller Willi Dickerson / John Mayhew

Lithologic Class. Scheme Folk/Wentworth Procedure PNL-MA-567, DO-1 Rev 1

Rig/Method CPT with Wire Line Sampler

Steel Tape/E-Tape NA / NA Field Indicator Equip. 1) NA 2) NA

Depth Control Point Ground Surface

DEPTH (Ft.)	TIME	SAMPLES TYPE	SAMPLES RECOVERY	MOISTURE	GRAPHIC LOG C Z S G	LITHOLOGIC DESCRIPTION (particle size distribution, sorting, mineralogy, roundness, color, reaction to HCl, etc.)	COLOR MUNSELL CODE	COLOR NAME	HCl REACTION	CASING LOG 6" 3" 0 3" 6"	DRILLING AND COMPLETION COMMENTS (drilling rate, down time, blow counts, water level, drill fluid, casing, seals, etc.)
0.0											Ground Surface
0.5	12:15										Started direct push, no sampling.
1.0											Location is near H-6. (70 cm from H6
1.5											and 140 cm from H4).
2.0											
2.5											
3.0											
3.5											
4.0											
4.5											With Todd Caldwell. Refer to his notes as
5.0											well.
5.5											
6.0											
6.5											
7.0											
7.5						Not Sampled.					
8.0											
8.5											
9.0											
9.5											2" ID Borehole.
10.0											
10.5											
11.0											
11.5											
12.0											
12.5											
13.0											
13.5											
14.0											
14.5											
15.0	12:24										Stopped direct push. Set up to sample.
15.5	12:28	WL		D		*SAND. Fine to medium. (not really much silt*	2.5Y7/2	light gray	strong		Note: No D.I. water to rinse samplers.
16.0						*VF sand)*					
16.5	12:30	WL		D-M		*SAND. Medium.*	2.5Y6/2	light brownish gray	weak		
17.0											
17.5	12:35	WL	80%	D-M		*SAND. Medium-very fine. A little finer than*	2.5Y7/2	light gray	weak - strong		
18.0						1 VF pebble.					
18.5	12:37	WL	80%	D-M		*SAND. Medium-very fine.*	2.5Y7/2	light gray	strong		Good moisture contact at 18.8'.
19.0				W-M		*SAND. Medium, on bottom. Wet to moist.*					
19.5	12:40	WL		M-W		*SAND. Medium to coarse.*	2.5Y6/2	light brownish gray (moist)	strong		
20.0											
20.5	12:46	WL	100%	M-W		*SAND. Medium to coarse.*	2.5Y5/2	brownish gray (moist)	weak - strong		
21.0											
21.5	12:50	WL	100%	M-W		*SAND. Coarse over Coarse-medium, with 1'*	2.5Y4/2	ark grayish brow (moist)	weak		
22.0											
22.5	12:51		0%								No recovery.
23.0											Note: Todd brought D.I. water. Samplers
23.5	12:58	WL	80%	D-M		*SAND. Coarse to medium.*	2.5Y6/1	gray	weak - none		can now be rinced.
24.0						1 VF pebble.					
24.5	13:01	WL	100%	D-M		*SAND. Coarse to medium.*	2.5Y6/1	gray	weak		
25.0											
25.5	13:03	WL	80%	M		*SAND. Coarse to medium. Wetter at bottom.*	2.5Y6/1	gray	weak - strong		
26.0				W							
26.5	13:06	WL	80%	W		*SAND. Medium. Drier at bottom.*	2.5Y6/1	gray	weak		
27.0				M							
27.5	13:08	WL	100%	M		*SAND. Medium.*	2.5Y6/2	light brownish gray	weak		
28.0											
28.5	13:10	WL	100%	M		*SAND. Medium.*	2.5Y6/1	gray	weak		
29.0											
29.5	13:13	WL	60%	M		*SAND. Medium.*	2.5Y6/1	gray	weak - strong		
30.0											
30.5	13:17	WL	80%	M		*SAND. Medium.*	2.5Y6/1	gray	weak		
31.0											
31.5	13:20	WL	80%	M		*SAND. Medium*	2.5Y6/1	gray	weak		

35.0							to 2.5Y6/2	lt. brownish gray		Neet Cement grout.
35.5	13:30	WL	100%	W	*SAND. Coarse to medium.*		2.5Y5/2	brownish gray	weak	
36.0					*SILTY SAND. Very fine sand to silt.*					
36.5	13:32	WL	100%	W	*SAND. Coarse.*		2.5Y4/2	ark grayish brow	weak	
37.0					*SILTY SAND. Very fine sand to silt.*			(moist)		
37.5	13:35	WL	60%	W	*SAND. Coarse, with thin VF Sand to silt lens*		2.5Y4/2	ark grayish brow	weak	
38.0								(moist)		
38.5	13:37	WL	100%	M-W	*SAND. Coarse to medium.*		2.5Y5/2	brownish gray	weak	
39.0								(moist)		
39.5	13:42	WL	100%	M-W	*SAND. Coarse to medium.*		2.5Y5/2	brownish gray	weak -	
40.0								(moist)	none	
40.5	13:49	WL	100%	M-W	*SAND. Coarse.*		2.5Y5/2	brownish gray	weak -	
41.0								(moist)	none	
41.5	13:53	WL	80%	M-W	*SAND. Coarse to medium.*		2.5Y5/2	brownish gray	weak -	
42.0								(moist)	none	
42.5	13:57	WL	75%	M	*SAND. Coarse to fine.*		2.5Y6/1	gray	weak	
43.0								(moist)		
43.5	14:05	WL	10%	M	*SAND. Medium.*					Having trouble with sampler.
44.0										
44.5	14:09	WL	70%	M	*SAND. Medium*		2.5Y6/1	gray	none	
45.0										
45.5	14:11	WL	50%	M	*SAND. Coarse to medium.*		2.5Y6/1	gray	weak -	
46.0									none	
46.5	14:14	WL	70%	M	*SAND. Medium*		2.5Y6/1	gray	weak	
47.0					1 VF pebble, angular.					
47.5	14:20	WL	5%	M-W	*SAND. Coarse to medium.*					
48.0										
48.5	14:57	WL	10%	M	*SAND. Medium.*		2.5Y6/2	light brownish	weak	Rebuilt sampling head (wireline)
49.0								gray		
49.5	15:00	WL	70%	M	*SAND. Medium.*		2.5Y6/2	light brownish	weak	No recovery.
50.0								gray		
50.5	15:04	WL	70%	M	*SAND. Coarse to medium.*		2.5Y6/1	gray to	weak	Could be some slough in top of sample.
51.0							to 2.5Y6/2	lt. brownish gray		
51.5	15:07	WL	100%	M	*SAND. Medium.*		2.5Y6/1	gray to	weak	
52.0							to 2.5Y6/2	lt. brownish gray		
52.5	15:09	WL	100%	M	*SAND. Medium.*		2.5Y6/2	light brownish	weak	
53.0								gray		
53.5	15:11	WL	100%	M	*SAND. Medium.*		2.5Y6/1	gray	weak	
54.0										
54.5	15:15	WL	70%	M-W	*SAND. Coarse to medium.*		2.5Y5/2	brownish gray	weak -	
55.0								(moist)	strong	
55.5	15:18	WL	70%	M-W	*SAND. Medium.*		2.5Y6/2	light brownish	weak	
56.0								gray		
56.5	15:21	WL	0%							No recovery. Pulling out of hole.
57.0										
57.5	14:46									Out of hole.
58.0										
58.5										
59.0										
59.5										Note: *Lithologic description based on field examination of chip sample* as well as later examination in the laboratory
60.0										

W = Wet, M = Moist, D = Dry

2000/GVL/GW-VZ S&T/001

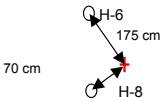
Pacific Northwest National Laboratory	**BOREHOLE LOG**	Boring/Well No: WL-12	Depth: 0-56'	Date: 6/8/2001	Sheet: 1 of 1
		Location: Sisson & Lu Site, 200 East Area	Project: VZTF Study		

Logged by G. V. Last (Print / Sign) **Drilling Contractor** Applied Research Assoc.

Reviewed by (Print / Sign) **Date** **Driller** Willi Dickerson / John Mayhew

Lithologic Class. Scheme Folk/Wentworth **Procedure** PNL-MA-567, DO-1 **Rev** 1 **Rig/Method** CPT with Wire Line Sampler

Steel Tape/E-Tape NA / NA **Field Indicator Equip.** 1) NA 2) NA **Depth Control Point** Ground Surface

DEPTH (Ft)	TIME	SAMPLES TYPE	SAMPLES RECOVERY	MOISTURE	GRAPHIC LOG C Z S G	LITHOLOGIC DESCRIPTION (particle size distribution, sorting, mineralogy, roundness, color, reaction to HCl, etc.)	COLOR MUNSELL CODE	COLOR NAME	HCl REACTION	CASING LOG 6" 3" 0 3" 6"	DRILLING AND COMPLETION COMMENTS (drilling rate, down time, blow counts, water level, drill fluid, casing, seals, etc.)
0.0											Ground Surface
0.5	8:30										Started direct push, no sampling.
1.0											Hole is located 70 cm North of H-8 and
1.5											175 cm East of H-6.
2.0											
2.5											
3.0											
3.5											
4.0											With Eric McGarrah, assisting with cleaning
4.5											of samplers.
5.0											
5.5											
6.0											
6.5											
7.0											
7.5						Not Sampled.					
8.0											
8.5											
9.0											
9.5											2" ID Borehole.
10.0											
10.5											
11.0											
11.5											
12.0											
12.5											
13.0											
13.5											
14.0											
14.5											
15.0	8:39										Stopped direct push, started wireline sampling.
15.5	8:41	WL	80%	D-M		*SAND. Medium.*	2.5Y7/2	light gray	weak -		
16.0						Some fines.			strong		
16.5	8:43	WL	80%	D-M		*SAND. Medium.*	2.5Y7/2	light gray	weak		
17.0											
17.5	8:45	WL	100%	D-M		*SAND. Medium.*	2.5Y7/2	light gray	weak		
18.0											
18.5	8:47	WL	90%	D-M		*SAND. Coarse to medium. Laminated. 1 thin*	2.5Y6/1	gray to	weak -		
19.0						*(wetter). Some coarser and finer laminati*	to 2.5Y6/2	lt. brownish gray	strong		
19.5	8:53	WL	60%	W-M		*SAND. Coarse.*	2.5Y6/2	light brownish gray	weak - strong		
20.0											
20.5	8:56	WL	100%	W-M		*SAND. Coarse. May be dry at very bottom.*	2.5Y6/2	light brownish gray	weak		
21.0											
21.5	8:58	WL	80%	M-D		*SAND. Medium.*	2.5Y7/2	light gray	weak -		
22.0						*SAND. Coarse to medium. Variable moistur*			strong		
22.5	8:59	WL	80%	M-D		*SAND. Medium.*	2.5Y7/1	light gray	weak		
23.0							to 7/2				
23.5	9:02	WL	80%	M		*SAND. Medium (moist)*	2.5Y7/2	light gray	weak		
24.0				D		*SAND. Medium (drier).* 1 VF pebble.					
24.5	9:05	WL	10%	M		*SAND. Medium to coarse.*					
25.0											
25.5	9:07	WL	100%	D		*SAND. Medium, poorly sorted.*	2.5Y6/2	light brownish gray	weak - strong		
26.0											
26.5	9:09	WL	90%	D-M		*SAND. Medium.*	2.5Y7/2	light gray to	weak -		
27.0							to 6/2	lt brownish gray	strong		
27.5	9:13	WL	100%	D-M		*SAND. Medium (some laminations).*	2.5Y6/2	light brownish gray	weak - strong		
28.0											
28.5	9:15	WL	80%	M		*SAND. Medium.*	2.5Y6/2	light brownish gray	weak		
29.0											
29.5	9:16	WL	80%	M		*SAND. Medium. Laminated. Some limonitic*	2.5Y6/2	light brownish gray	weak		
30.0											
30.5	9:20	WL	100%	M-D		*SAND. Medium. May be coarser at the bott*	2.5Y6/2	light brownish gray	weak		
31.0											
31.5	9:23	WL	100%	M		*SAND. Medium, over 1" thick VF sand to sil*	2.5Y6/2	light brownish	weak		

35.0				M	*SAND. Medium (drier).*		(moist)		
35.5	9:35	WL	100%	W-D	*SAND. Coarse to medium, laminated with V*	2.5Y6/2	light brownish gray	weak	
36.0					*silt (wet).*				
36.5	9:37	WL	100%	M	*SAND. Coarse to medium, to F-M.*	2.5Y6/2	light brownish gray	weak	
37.0					*SILT. (wetter)*				
37.5	9:39	WL	100%	M-W	*SILT. (at top, 2-3" thick)*	2.5Y4/2	ark grayish brow	weak	
38.0					*SAND. Coarse, laminated, with fines.*		(moist)		
38.5	9:43	WL	100%	M-D	*SAND. Medium, laminated - variable moistu*	2.5Y6/1	gray	weak	
39.0					*Clean, little fines.*				
39.5	9:49	WL	70%	M	*SAND. Coarse to medium, with 1" VF. Sand*	2.5Y5/2	brownish gray	weak - none	
40.0					*Variable moisture.*				
40.5	9:53	WL	90%	M-W	*SAND. Coarse to medium, laminated. Wette*	2.5Y6/1	gray	weak	
41.0									
41.5	9:55	WL	80%	M-W	*SAND. Coarse to medium.*	2.5Y6/1	gray to	none	
42.0					Some VC sand to VF pebble.	to 2.5Y6/2	lt. brownish gray		
42.5	9:56	WL	80%	M	*SAND. Coarse to fine, laminated. Variable n*	2.5Y6/1	gray to	weak	
43.0					Some VC sand to VF pebble.	to 2.5Y6/2	lt. brownish gray		
43.5	10:00	WL	80%	M-W	*SAND. Coarse to medium.*	2.5Y6/2	light brownish gray	weak	
44.0									
44.5	10:01	WL	70%	M-W	*SAND. Coarse.*	2.5Y6/2	light brownish gray	weak	
45.0					1 Fine pebble.				
45.5	10:02	WL	80%	M-W	*SAND. Coarse.*	2.5Y6/1	gray to	weak - none	
46.0					*SAND. Medium (drier)*	to 2.5Y6/2	lt. brownish gray		
46.5	10:06	WL	80%	M-W	*SAND. Coarse.*	2.5Y6/1	gray to	weak - none	
47.0					*SAND. Medium (drier)*	to 2.5Y6/2	lt. brownish gray		
47.5	10:07	WL	80%	M-W	*SAND. Coarse (some VC sand to VF pebble)*	2.5Y6/1	gray to	weak - none	
48.0					*SAND. Medium.*	to 2.5Y6/2	lt. brownish gray		
48.5	10:10	WL	90%	M	*SAND. Coarse to medium.*	2.5Y6/2	light brownish gray	weak - strong	
49.0					1 VF-F pebble, angular.				
49.5	10:12	WL	80%	M-W	*SAND. Coarse to medium, some F. sand lam*	2.5Y5/2	brownish gray (moist)	weak	
50.0					1 Fine pebble (subround).				
50.5	10:15	WL	100%	M-W	*SAND. Medium.*	2.5Y5/2	brownish gray (moist)	weak	
51.0									
51.5	10:17	WL	100%	W	*SAND. Coarse*	2.5Y5/2	brownish gray	weak	
52.0				M	*SAND. Fine (drier)*		(moist)		
52.5	10:19	WL	100%	M	*SAND. Medium*	2.5Y5/2 - 4/2	brownish gray (moist)	weak	
53.0									
53.5	10:23	WL	100%	M	*SAND. Medium to fine.*	2.5Y6/2	light brownish gray (moist)	weak	
54.0									
54.5	10:25	WL	100%	M-W	*SAND. Coarse to very coarse.*	2.5Y5/2	brownish gray (moist)	strong	
55.0					*SAND. Medium to fine.*				
55.5	10:27	WL	100%	M-W	*SAND. Coarse to very coarse, laminated wit*	2.5Y6/2	light brownish gray (moist)	weak	
56.0									
56.5	10:30								Tripping out of hole
57.0	10:46								Out of hole.
57.5	10:56								Grouting hole with neet cement. Using
58.0									Portland Type I/II cement - 1.5 bags to
58.5									20-22 gal. H2O. Grout poured downhole
59.0	11:17								from bucket. Demobe from site.
59.5									
60.0									

Neet Cement grout.

Note: *Lithologic description based on field examination of chip sample* as well as later examination in the laboratory

W = Wet, M = Moist, D = Dry

2000/GVL/GW-VZ S&T/001

Appendix B

Percent Fine Data

Borehole ID	Sample ID	Depth (ft)	Date Sampled	Dry Soil Wt. (g)	Sieve Tare Wt. (g)	Sieve + Retained Soil Dry Wt. (g)	Retained Soil Dry Wt. (g)	% Fine
WL-5	17-18'	17.5	4/16/2001	20.04	344.19	361.65	17.46	12.87
WL-5	18-19'	18.5	4/16/2001	20.04	294.54	311.95	17.41	13.12
WL-5	19-20'	19.5	4/16/2001	19.99	292.27	309.04	16.77	16.11
WL-5	22-23'	22.5	4/16/2001	19.99	299.95	316.89	16.94	15.26
WL-5	33-34'	33.5	4/16/2001	20.03	351.71	369.10	17.39	13.18
WL-5	37-38'	37.5	4/16/2001	20.03	344.21	360.98	16.77	16.28
WL-5	38-39'	38.5	4/16/2001	20.03	294.55	311.38	16.83	15.98
WL-5	42-43'	42.5	4/16/2001	20.03	292.17	310.38	18.21	9.09
WL-6	15-16'	15.5	4/16/2001	20.00	344.17	361.57	17.40	13.00
WL-6	18-19'	18.5	4/16/2001	20.03	292.22	308.86	16.64	16.92
WL-6	19-20'	19.5	4/16/2001	20.01	294.55	311.86	17.31	13.49
WL-6	22-23'	22.5	4/16/2001	20.02	299.91	316.92	17.01	15.03
WL-6	33-34'	33.5	4/16/2001	20.02	351.69	368.94	17.25	13.84
WL-6	37-38'	37.5	4/16/2001	19.99	344.15	360.41	16.26	18.66
WL-6	38-39'	38.5	4/16/2001	20.01	292.21	308.59	16.38	18.14
WL-6	42-43'	42.5	4/16/2001	20.00	294.56	312.58	18.02	9.90
WL-6	52-53'	52.5	4/16/2001	20.00	299.89	317.34	17.45	12.75
WL-7	17-18'	17.5	5/9/2001	20.01	351.69	368.29	16.60	17.04
WL-7	18-19'	18.5	5/9/2001	20.03	344.20	361.70	17.50	12.63
WL-7	19-20'	19.5	5/9/2001	20.02	293.78	308.77	14.99	25.12
WL-7	22-23'	22.5	5/9/2001	20.00	294.57	311.10	16.53	17.35
WL-7	33-34'	33.5	5/9/2001	20.01	299.88	315.98	16.10	19.54
WL-7	38-39'	38.5	5/9/2001	20.01	351.71	368.02	16.31	18.49
WL-7	42-43'	42.5	5/9/2001	19.99	344.18	362.00	17.82	10.86
WL-7	52-53'	52.5	5/9/2001	20.03	292.17	309.30	17.13	14.48
WL-8	17-18'	17.5	5/10/2001	20.03	344.18	360.81	16.63	16.97
WL-8	18-19'	18.5	5/10/2001	19.99	294.55	311.35	16.80	15.96
WL-8	19-20'	19.5	5/10/2001	20.03	335.43	351.57	16.14	19.42
WL-8	22-23'	22.5	5/10/2001	20.02	299.87	316.14	16.27	18.73
WL-8	33-34'	33.5	5/10/2001	20.00	351.69	368.71	17.02	14.90
WL-8	37-38'	37.5	5/10/2001	20.01	344.19	361.67	17.48	12.64
WL-8	38-39'	38.5	5/10/2001	20.02	294.56	310.99	16.43	17.93
WL-8	42-43'	42.5	5/10/2001	20.00	335.45	352.68	17.23	13.85
WL-8	52-53'	52.5	5/10/2001	20.00	299.87	316.57	16.70	16.50
WL-9	17-18'	17.5	5/23/2001	19.99	344.21	361.46	17.25	13.71
WL-9	18-19'	18.5	5/23/2001	19.98	294.58	311.62	17.04	14.71
WL-9	19-20'	19.5	5/23/2001	19.99	335.75	352.40	16.65	16.71
WL-9	22-23'	22.5	5/23/2001	20.02	299.88	316.31	16.43	17.93
WL-9	33-34'	33.5	5/23/2001	20.02	351.93	369.12	17.19	14.14
WL-9	37-38'	37.5	5/23/2001	20.02	344.21	358.92	14.71	26.52
WL-9	38-39'	38.5	5/23/2001	20.03	294.57	312.68	18.11	9.59
WL-9	42-43'	42.5	5/23/2001	20.01	335.70	353.29	17.59	12.09
WL-9	52-53'	52.5	5/23/2001	20.01	299.87	317.25	17.38	13.14

Borehole ID	Sample ID	Depth (ft)	Date Sampled	Dry Soil Wt. (g)	Sieve Tare Wt. (g)	Sieve + Retained Soil Dry Wt. (g)	Retained Soil Dry Wt. (g)	% Fine
WL-10	17-18'	17.5	5/23/2001	20.01	351.92	368.84	16.92	15.44
WL-10	18-19'	18.5	5/23/2001	19.99	344.20	360.94	16.74	16.26
WL-10	19-20'	19.5	5/23/2001	19.99	294.55	311.45	16.90	15.46
WL-10	22-23'	22.5	5/23/2001	20.01	335.72	352.59	16.87	15.69
WL-10	33-34'	33.5	5/23/2001	20.02	300.14	316.24	16.10	19.58
WL-10	37-38'	37.5	5/23/2001	19.99	351.96	367.22	15.26	23.66
WL-10	38-39'	38.5	5/23/2001	19.99	344.19	360.30	16.11	19.41
WL-10	42-43'	42.5	5/23/2001	20.01	294.57	312.87	18.30	8.55
WL-10	52-53'	52.5	5/23/2001	20.00	335.72	352.43	16.71	16.45
WL-11	17-18'	17.5	6/5/2001	20.01	299.87	316.98	17.11	14.49
WL-11	18-19'	18.5	6/5/2001	20.00	351.90	368.34	16.44	17.80
WL-11	19-20'	19.5	6/5/2001	20.00	344.17	360.65	16.48	17.60
WL-11	23-24'	23.5	6/5/2001	20.00	294.57	313.37	18.80	6.00
WL-11	33-34'	33.5	6/5/2001	20.00	335.70	352.14	16.44	17.80
WL-11	37-38'	37.5	6/5/2001	20.01	299.91	314.12	14.21	28.99
WL-11	38-39'	38.5	6/5/2001	20.02	351.94	369.34	17.40	13.09
WL-11	42-43'	42.5	6/5/2001	20.01	344.17	361.94	17.77	11.19
WL-11	52-53'	52.5	6/5/2001	19.99	294.56	311.73	17.17	14.11
WL-12	17-18'	17.5	6/8/2001	20.00	335.70	352.53	16.83	15.85
WL-12	18-19'	18.5	6/8/2001	20.02	299.87	316.38	16.51	17.53
WL-12	19-20'	19.5	6/8/2001	20.02	351.91	368.58	16.67	16.73
WL-12	23-24'	23.5	6/8/2001	20.00	344.19	362.28	18.09	9.55
WL-12	33-34'	33.5	6/8/2001	20.02	294.57	311.73	17.16	14.29
WL-12	37-38'	37.5	6/8/2001	20.01	335.69	350.41	14.72	26.44
WL-12	38-39'	38.5	6/8/2001	20.00	299.85	316.70	16.85	15.75
WL-12	42-43'	42.5	6/8/2001	20.00	351.91	369.56	17.65	11.75
WL-12	52-53'	52.5	6/8/2001	20.00	344.16	361.44	17.28	13.60

Appendix C

Moisture Content Data

Water Content WL-3A (S-7)

Analyst: Scale Number:

Analysis date: Callibration date:

Sample ID	Depth (ft)	Beaker No.	Beaker Wt. (g)	Soil/Beaker Wet Wt. (g)	Soil/Beaker Dry Wt. (g)	% Water	Comments
15-16	15.50	52	30.06	59.58	58.90	2.36%	
16-17	16.50	50	29.89	245.66	240.71	2.35%	
17-18	17.50	38	30.17	276.55	271.08	2.27%	
18-19	18.50	21	30.07	269.47	263.46	2.58%	
19-20	19.50	8	29.42	84.42	81.65	5.30%	
20-21	20.50	5	30.28	277.88	264.69	5.63%	
21-22	21.50	6	30.08	278.52	267.88	4.47%	
22-23	22.50	7	28.25	247.61	238.04	4.56%	
23-24	23.50	1A	29.70	264.64	252.44	5.48%	
24-25	24.50	41	40.05	218.23	214.47	2.16%	
25-26	25.50	2	30.06	197.06	193.30	2.30%	
25-26D	25.50	34	30.06	79.98	78.87	2.27%	
26-27	26.50	36	30.16	114.12	111.87	2.75%	
27-28	27.50	10	26.86	178.29	173.98	2.93%	
28-29	28.50	4	30.24	193.72	189.14	2.88%	
29-30	29.50	49	30.16	115.25	113.05	2.65%	
30-31	30.50	3	30.45	174.99	170.33	3.33%	
31-32	31.50	19	30.28	163.45	158.53	3.84%	
31-32D	31.50	43	29.77	119.46	116.08	3.92%	
32-33	32.50	1	30.27	152.31	145.62	5.80%	
33-34	33.50	48	30.30	110.67	108.35	2.97%	
34-35	34.50	53	30.30	188.53	183.22	3.47%	
35-36	35.50	30	29.98	171.35	164.51	5.08%	
35-36D	35.50	A	30.08	146.02	140.61	4.89%	
36-37	36.50	51	29.99	154.81	146.71	6.94%	
37-38	37.50	K	30.10	193.10	179.00	9.47%	
38-39	38.50	22	30.02	127.14	121.06	6.68%	
39-40	39.50	I	30.23	193.43	189.68	2.35%	
40-41	40.50	L	29.96	175.15	171.77	2.38%	
41-42D	40.50	13	30.17	103.03	101.24	2.52%	
41-42	41.50	J	30.29	175.52	172.05	2.45%	
42-43	42.50	M	30.05	202.36	197.45	2.93%	
43-44	43.50	E	29.99	173.70	169.67	2.89%	
44-45	44.50	H	30.36	71.79	70.75	2.57%	
45-46	45.50	N	30.07	192.97	188.55	2.79%	
46-47	46.50	G	29.89	192.61	188.13	2.83%	
47-48	47.50	O	30.09	217.61	212.62	2.73%	
48-49	48.50	F	30.18	197.80	193.56	2.60%	
49-50	49.50	56	30.15	106.77	105.00	2.36%	
50-51	50.50	40	30.12	186.02	182.29	2.45%	
51-52	51.50	31	30.07	158.69	155.41	2.62%	
51-52D	51.50	B	30.46	110.69	108.54	2.75%	
52-53	52.50	28	30.18	154.38	150.67	3.08%	
53-54	53.50	14	30.02	186.29	181.85	2.92%	
54-55	54.50	46	29.89	118.32	115.23	3.62%	

Water Content WL-4 (S-8)

Analyst: Scale Number:

Analysis date: Callibration date:

Sample ID	Depth (ft)	Beaker No.	Beaker Wt. (g)	Soil/Beaker Wet Wt. (g)	Soil/Beaker Dry Wt. (g)	% Water	Comments
15-16	15.50	15	27.06	163.85	160.87	2.23%	
16-17	16.50	25	30.04	209.38	205.24	2.36%	
17-18	17.50	26	30.20	190.24	186.41	2.45%	
18-19	18.50	C	30.18	191.13	186.45	2.99%	
19-20	19.50	23	29.97	165.81	159.50	4.87%	
19-20D	19.50	4A	30.22	135.11	129.69	5.45%	
20-21	20.50	44	30.13	119.14	115.85	3.84%	
21-22	21.50	11	30.02	200.31	196.28	2.42%	
22-23	22.50	39	29.86	231.23	226.67	2.32%	
23-24	23.50	47	30.25	219.68	215.68	2.16%	
24-25	24.50	20	30.26	214.83	211.51	1.83%	
28-29	28.50	33	30.17	192.46	188.46	2.53%	
32-33	32.50	35	30.16	227.29	223.43	2.00%	
35-36	35.50	24	30.21	212.45	207.16	2.99%	
36-37	36.50	16	30.13	193.23	186.50	4.30%	
37-38	37.50	32	30.03	139.61	128.05	11.79%	
38-39	38.50	12	30.06	163.45	156.21	5.74%	
38-39D	38.50	2A	30.20	104.39	100.40	5.68%	
39-40	39.50	D	30.31	170.45	167.48	2.17%	
40-41	40.50	37	30.30	147.75	145.11	2.30%	
40-41D	40.50	10A	30.08	123.94	121.88	2.24%	
43-44	43.50	29	30.20	82.01	80.87	2.25%	
46-47	46.50	6A	30.11	195.47	191.38	2.54%	
49-50	49.50	7A	29.86	185.93	182.31	2.37%	
52-53	52.50	15A	30.39	172.97	169.68	2.36%	
52-53D	52.50	Z	30.21	101.54	99.81	2.49%	

Water Content WL-5 Collection date: 17-Apr-05

Analyst: Karen Waters-Husted Scale Number: 512-06-01-013

Analysis date: 18-Apr-05 Callibration date: 28-Feb-05

Sample ID	Depth (ft)	Beaker No.	Beaker Wt. (g)	Soil/Beaker Wet Wt. (g)	Soil/Beaker Dry Wt. (g)	% Water	Comments
15-16	15.5	6A	30.13	217.62	213.60	2.19%	
16-17	16.5	26	30.18	233.29	228.92	2.20%	
17-18	17.5	22	30.06	250.42	245.40	2.33%	
18-19	18.5	56	30.13	261.76	254.37	3.30%	
19-20	19.5	47	30.28	291.65	278.27	5.40%	
20-21	20.5	30	29.98	305.18	287.82	6.73%	
21-22	21.5	13	30.18	264.39	254.83	4.26%	
22-23	22.5	46	29.89	277.68	265.89	5.00%	
23-24	23.5	4A	30.23	255.90	243.88	5.63%	
24-25	24.5	28	30.18	235.77	227.82	4.02%	
25-26	25.5	23	29.97	215.03	208.11	3.88%	
26-27	26.5	25	30.05	274.31	262.99	4.86%	
27-28	27.5	51	29.99	259.31	248.26	5.06%	
28-29	28.5	36	30.14	258.10	248.16	4.56%	
29-30	29.5	40	30.12	265.63	254.82	4.81%	
30-31	30.5	35	30.16	236.59	227.13	4.80%	
31-32	31.5	31	30.06	250.60	241.64	4.23%	
32-33	32.5	39	29.84	263.27	245.03	8.48%	
33-34	33.5	24	30.19	206.12	199.82	3.71%	
34-35	34.5	44	30.12	272.45	263.73	3.73%	
35-36	35.5	11	29.99	291.80	279.21	5.05%	
36-37	36.5	16	30.13	244.72	236.06	4.21%	
37-38	37.5	C	30.16	285.56	268.99	6.94%	
38-39	38.5	37	30.30	231.37	219.46	6.30%	
39-40	39.5	33	30.18	223.98	219.71	2.25%	
40-41	40.5	14	30.01	245.99	241.04	2.35%	
41-42	41.5	20	30.26	219.31	214.67	2.52%	
42-43	42.5	19	30.28	229.14	223.68	2.82%	
43-44	43.5	D	30.26	187.57	183.56	2.62%	
44-45	44.5	2A	30.22	250.89	244.64	2.91%	
45-46	45.5	32	30.00	231.22	225.84	2.75%	
46-47	46.5	12	30.07	216.31	211.44	2.69%	
47-48	47.5	10A	30.09	75.77	74.78	2.22%	
48-49	48.5	29	30.21	246.21	240.83	2.55%	
49-50	49.5	J	30.28	235.29	230.52	2.38%	

Water Content WL-6 Collection date: 17-Apr-05

Analyst: Karen Waters-Husted Scale Number: 512-06-01-013

Analysis date: Callibration date: 28-Feb-05

Sample ID	Depth (ft)	Beaker No.	Beaker Wt. (g)	Soil/Beaker Wet Wt. (g)	Soil/Beaker Dry Wt. (g)	% Water	Comments
15-16	15.5	37	30.30	98.81	97.34	2.19%	
18-19	18.5	29	30.21	236.01	229.29	3.38%	
19-20	19.5	14	30.02	279.65	266.34	5.63%	
20-21	20.5	36	30.15	277.35	262.73	6.29%	
21-22	21.5	28	30.19	195.81	188.12	4.87%	
22-23	22.5	44	30.12	112.67	108.39	5.47%	
23-24	23.5	25	30.05	119.12	114.63	5.31%	
24-25	24.5	C	30.15	122.42	120.40	2.24%	
25-26	25.5	19	30.27	118.30	116.21	2.43%	
26-27	26.5	2A	30.21	131.78	128.98	2.83%	
27-28	27.5	23	29.98	125.98	123.32	2.85%	
28-29	28.5	13	30.18	121.92	119.47	2.74%	
29-30	29.5	26	30.19	114.42	112.13	2.79%	
30-31	30.5	J	30.29	120.14	117.43	3.11%	
31-32	31.5	10A	30.10	114.69	112.02	3.26%	
32-33	32.5	39	29.86	112.69	108.14	5.81%	
33-34	33.5	12	30.07	144.73	140.64	3.70%	
35-36	35.5	24	30.20	130.87	126.28	4.78%	
36-37	36.5	51	30.00	145.42	139.34	5.56%	
37-38	37.5	40	30.12	174.68	164.61	7.49%	
38-39	38.5	D	30.26	127.43	121.55	6.44%	
39-40	39.5	4A	30.23	133.40	130.84	2.54%	
40-41	40.5	11	30.03	118.21	116.04	2.52%	
41-42	41.5	33	30.20	120.41	118.11	2.62%	
42-43	42.5	16	30.13	103.06	100.85	3.13%	
43-44	43.5	6A	30.13	130.75	128.07	2.74%	
44-45	44.5	47	30.27	124.25	121.29	3.25%	
45-46	45.5	22	30.07	126.13	123.32	3.01%	
46-47	46.5	20	30.27	143.54	140.16	3.08%	
47-48	47.5	32	30.01	151.43	147.88	3.01%	
48-49	48.5	35	30.16	146.84	143.67	2.79%	
49-50	49.5	46	29.90	137.49	134.81	2.55%	
50-51	50.5	31	30.07	154.29	151.04	2.69%	
51-52	51.5	30	29.98	144.12	141.21	2.62%	
52-53	52.5	56	30.15	116.93	114.43	2.97%	
53-54	53.5	H	30.37	146.77	143.52	2.87%	
54-55	54.5	E	29.99	125.01	122.36	2.87%	

Water Content WL-7 Collection date: 10-May-05

Analyst: Karen Waters-Husted Scale Number: 512-06-01-013

Analysis date: 31-May-05 Callibration date: 28-Feb-05

Sample ID	Depth (ft)	Beaker No.	Beaker Wt. (g)	Soil/Beaker Wet Wt. (g)	Soil/Beaker Dry Wt. (g)	% Water	Comments
15-16	15.5	10	26.86	230.87	225.50	2.70%	
16-17	16.5	55	29.86	222.31	217.15	2.76%	
17-18	17.5	2C	29.97	255.15	247.43	3.55%	
18-19	18.5	53	30.32	136.00	128.07	8.11%	
19-20	19.5	49	30.18	256.55	234.01	11.06%	
20-21	20.5	43	29.76	286.72	257.60	12.78%	
21-22	21.5	38	30.18	216.87	203.57	7.67%	
22-23	22.5	21	30.06	243.13	231.11	5.98%	
23-24	23.5	52	30.07	117.94	111.89	7.39%	
24-25	24.5	13	28.19	229.77	220.84	4.64%	
25-26	25.5	7	28.25	236.16	226.73	4.75%	
26-27	26.5	2	30.28	182.31	174.37	5.51%	
27-28	27.5	18	29.94	261.89	247.88	6.43%	
28-29	28.5	27	30.31	243.28	230.88	6.18%	
29-30	29.5	54	30.22	137.39	130.50	6.87%	
30-31	30.5	5	30.29	256.94	241.68	7.22%	
31-32	31.5	9	30.34	235.96	219.99	8.42%	
32-33	32.5	3	30.18	244.35	225.88	9.44%	
33-34	33.5	11	30.29	150.78	144.83	5.19%	
34-35	34.5	14	30.07	211.21	200.34	6.38%	
35-36	35.5	4	30.09	288.03	270.36	7.35%	
36-37	36.5	17	30.03	196.64	186.09	6.76%	
37-38	37.5	16	30.10	111.35	106.53	6.31%	
38-39	38.5	20	29.95	241.10	227.02	7.14%	
39-40	39.5	19	30.13	95.48	93.86	2.54%	
40-41	40.5	12	30.01	239.98	234.68	2.59%	
41-42	41.5	6	30.27	226.86	221.70	2.70%	
42-43	42.5	8	30.22	198.67	193.74	3.01%	
43-44	43.5	1	30.11	205.99	201.49	2.63%	
45-46	45.5	15	30.12	216.23	210.86	2.97%	
46-47	46.5	22	29.97	148.59	145.78	2.43%	
48-49	48.5	23	30.28	80.63	79.32	2.67%	
49-50	49.5	24	30.12	225.57	221.04	2.37%	
51-52	51.5	25	29.93	172.13	168.96	2.28%	
52-53	52.5	26	30.19	101.40	99.57	2.64%	

Water Content WL-8 Collection date: 11-May-05

Analyst: Karen Waters-Husted Scale Number: 512-06-01-013

Analysis date: 1-Jun-05 Callibration date: 28-Feb-05

Sample ID	Depth (ft)	Beaker No.	Beaker Wt. (g)	Soil/Beaker Wet Wt. (g)	Soil/Beaker Dry Wt. (g)	% Water	Comments
15-16	15.5	2	30.25	229.11	224.95	2.14%	
16-17	16.5	2C	29.95	213.30	209.55	2.09%	
17-18	17.5	3	30.17	248.81	244.03	2.24%	
18-19	18.5	4	30.09	176.84	171.61	3.70%	
19-20	19.5	5	30.27	131.12	125.67	5.71%	
20-21	20.5	7	28.25	262.42	250.24	5.49%	
21-22	21.5	9	30.28	262.34	252.13	4.60%	
22-23	22.5	10	26.86	252.56	243.50	4.18%	
23-24	23.5	11	30.28	93.70	89.65	6.82%	
24-25	24.5	13	28.15	221.68	217.38	2.27%	
25-26	25.5	14	30.07	181.41	178.04	2.28%	
26-27	26.5	16	30.09	195.47	191.44	2.50%	
27-28	27.5	17	30.03	247.45	241.58	2.77%	
28-29	28.5	18	29.93	172.56	168.77	2.73%	
29-30	29.5	20	29.95	81.38	80.12	2.51%	
30-31	30.5	21	30.07	233.64	227.49	3.12%	
31-32	31.5	27	30.30	215.31	209.76	3.09%	
32-33	32.5	38	30.17	257.33	243.83	6.32%	
33-34	33.5	43	29.76	136.41	132.00	4.31%	
34-35	34.5	49	30.16	250.89	238.86	5.76%	
35-36	35.5	52	30.06	239.66	227.70	6.05%	
36-37	36.5	53	30.33	110.67	106.72	5.17%	
37-38	37.5	54	30.20	121.84	117.45	5.03%	
38-39	38.5	55	29.85	135.91	129.67	6.25%	
39-40	39.5	28	30.21	209.05	204.76	2.46%	
40-41	40.5	1	30.01	219.44	214.74	2.54%	
41-42	41.5	2	30.25	210.19	205.60	2.62%	
42-43	42.5	3	30.18	68.22	67.33	2.40%	
43-44	43.5	4	30.09	169.74	166.01	2.74%	
44-45	44.5	5	30.28	259.00	252.87	2.75%	
45-46	45.5	6	30.26	91.52	89.94	2.65%	
46-47	46.5	7	28.25	116.75	114.62	2.47%	
47-48	47.5	8	30.21	218.65	214.25	2.39%	
48-49	48.5	9	30.28	217.63	213.07	2.49%	
49-50	49.5	10	26.86	231.97	226.34	2.82%	
50-51	50.5	11	30.28	226.42	221.70	2.47%	
51-52	51.5	12	30.00	222.65	218.05	2.45%	
52-53	52.5	13	28.15	92.75	91.17	2.51%	
53-54	53.5	14	30.06	178.47	174.73	2.59%	

Water Content WL-9 Collection date: 10-May-05

Analyst: Karen Waters-Husted Scale Number: 512-06-01-013

Analysis date: 31-May-05 Callibration date: 28-Feb-05

Sample ID	Depth (ft)	Beaker No.	Beaker Wt. (g)	Soil/Beaker Wet Wt. (g)	Soil/Beaker Dry Wt. (g)	% Water	Comments
15-16	15.5	15	30.11	230.09	225.59	2.30%	
16-17	16.5	16	30.11	228.22	223.76	2.30%	
17-18	17.5	17	30.04	214.53	210.12	2.45%	
18-19	18.5	18	29.93	228.86	222.81	3.14%	
19-20	19.5	19	30.13	150.61	144.71	5.15%	
20-21	20.5	20	29.96	265.95	249.89	7.30%	
21-22	21.5	21	30.07	236.18	224.54	5.99%	
22-23	22.5	22	29.97	209.29	198.35	6.50%	
23-24	23.5	23	30.28	88.54	86.99	2.73%	
25-26	25.5	24	30.13	221.17	217.07	2.19%	
26-27	26.5	25	29.93	192.13	187.86	2.70%	
27-28	27.5	26	30.19	240.32	234.56	2.82%	
28-29	28.5	27	30.29	107.99	106.01	2.61%	
29-30	29.5	28	30.20	185.34	181.44	2.58%	
30-31	30.5	38	30.18	249.83	243.48	2.98%	
31-32	31.5	43	29.76	237.06	230.04	3.51%	
32-33	32.5	49	30.17	192.33	184.78	4.88%	
33-34	33.5	52	30.06	127.36	123.33	4.32%	
34-35	34.5	53	30.33	253.46	245.96	3.48%	
35-36	35.5	54	30.21	262.51	252.43	4.54%	
36-37	36.5	55	29.86	246.66	227.26	9.83%	
37-38	37.5	2C	29.94	118.66	109.99	10.83%	
38-39	38.5	29	30.15	175.18	168.65	4.71%	
39-40	39.5	30	30.12	105.67	102.10	4.96%	
40-41	40.5	31	30.19	237.68	228.81	4.47%	
41-42	41.5	32	30.22	222.74	217.27	2.92%	
42-43	42.5	1	30.02	205.51	201.38	2.41%	
43-44	43.5	2	30.25	177.40	173.30	2.87%	
44-45	44.5	3	30.16	202.25	197.75	2.69%	
45-46	45.5	4	30.09	215.63	211.31	2.38%	
46-47	46.5	5	30.27	205.75	201.75	2.33%	
47-48	47.5	6	30.26	85.91	84.69	2.24%	
48-49	48.5	7	28.25	210.06	205.30	2.69%	
49-50	49.5	8	30.19	224.12	216.90	3.87%	
50-51	50.5	9	30.27	130.00	124.84	5.46%	
51-52	51.5	10	26.86	234.68	224.82	4.98%	
52-53	52.5	11	30.28	249.55	237.42	5.86%	
53-54	53.5	12	30.00	263.20	250.98	5.53%	
54-55	54.5	13	28.15	241.91	231.61	5.06%	
55-56	55.5	14	30.06	194.46	186.73	4.93%	
56-57	56.5	15	30.12	256.11	248.36	3.55%	

Water Content WL-10 Collection date: 11-May-05

Analyst: Karen Waters-Husted Scale Number: 512-06-01-013

Analysis date: 1-Jun-05 Callibration date: 28-Feb-05

Sample ID	Depth (ft)	Beaker No.	Beaker Wt. (g)	Soil/Beaker Wet Wt. (g)	Soil/Beaker Dry Wt. (g)	% Water	Comments
15-16	15.5	32	30.22	227.02	222.86	2.16%	
15-16A	15.5	13	28.16	199.65	184.23	9.88%	
16-17	16.5	16	30.09	224.52	220.38	2.18%	
17-18	17.5	38	30.17	248.90	243.82	2.38%	
18-19	18.5	43	29.75	258.83	250.88	3.60%	
19-20	19.5	17	30.03	147.38	140.11	6.60%	
20-21	20.5	18	29.92	265.96	251.22	6.66%	
21-22	21.5	19	30.13	249.27	238.94	4.95%	
22-23	22.5	20	29.96	246.98	232.91	6.93%	
23-24	23.5	21	30.08	96.74	94.37	3.69%	
24-25	24.5	22	29.97	211.03	203.98	4.05%	
25-26	25.5	23	30.27	257.21	247.27	4.58%	
26-27	26.5	24	30.12	251.73	240.81	5.18%	
27-28	27.5	25	29.93	233.59	223.39	5.27%	
28-29	28.5	26	30.19	132.51	127.56	5.08%	
29-30	29.5	27	30.29	251.46	239.52	5.71%	
30-31	30.5	28	30.19	245.03	231.73	6.60%	
31-32	31.5	29	30.14	257.95	243.00	7.02%	
32-33	32.5	30	30.12	265.28	242.60	10.67%	
33-34	33.5	31	30.19	129.69	124.19	5.85%	
34-35	34.5	49	30.16	273.59	261.30	5.32%	
35-36	35.5	52	30.07	128.37	123.47	5.25%	
36-37	36.5	53	30.32	266.76	248.78	8.23%	
37-38	37.5	54	30.20	126.54	117.08	10.89%	
38-39	38.5	55	29.87	168.93	158.42	8.18%	
39-40	39.5	2C	29.95	260.72	251.89	3.98%	
40-41	40.5	I	30.24	90.99	88.79	3.76%	
41-42	41.5	M	30.06	186.65	180.46	4.12%	
42-43	42.5	N	30.07	177.63	172.40	3.67%	
43-44	43.5	1	30.01	205.16	200.02	3.02%	
44-45	44.5	2	30.26	180.82	176.11	3.23%	
45-46	45.5	3	30.17	71.53	70.24	3.22%	
46-47	46.5	4	30.09	207.64	200.96	3.91%	
47-48	47.5	5	30.29	218.03	212.74	2.90%	
48-49	48.5	6	30.21	192.97	188.70	2.69%	
50-51	50.5	7	28.24	232.55	227.72	2.42%	
51-52	51.5	8	30.19	171.08	167.05	2.94%	
52-53	52.5	9	30.25	235.58	229.42	3.09%	
53-54	53.5	10	26.85	113.32	110.71	3.11%	
54-55	54.5	11	30.29	258.83	248.86	4.56%	
55-56	55.5	12	30.00	246.85	237.10	4.71%	

Water Content WL-11 Collection date: 6-Jun-05

Analyst: Karen Waters-Husted Scale Number: 512-06-01-013

Analysis date: 12-Jun-05 Callibration date: 28-Feb-05

Sample ID	Depth (ft)	Beaker No.	Beaker Wt. (g)	Soil/Beaker Wet Wt. (g)	Soil/Beaker Dry Wt. (g)	% Water	Comments
15-16	15.5	1	29.99	228.53	224.16	2.25%	
16-17	16.5	2	30.25	234.45	230.00	2.23%	
17-18	17.5	3	30.18	235.04	230.12	2.46%	
18-19	18.5	4	30.10	243.37	236.74	3.21%	
19-20	19.5	5	30.28	283.10	267.10	6.76%	
20-21	20.5	6	30.26	277.32	262.28	6.48%	
21-22	21.5	7	28.24	275.17	260.37	6.38%	
23-24	23.5	8	30.20	185.90	181.81	2.70%	
24-25	24.5	9	30.27	251.16	245.52	2.62%	
25-26	25.5	10	26.85	221.02	213.02	4.30%	
26-27	26.5	11	30.29	237.89	229.43	4.25%	
27-28	27.5	12	30.01	270.12	260.62	4.12%	
28-29	28.5	13	28.16	222.80	214.54	4.43%	
29-30	29.5	14	30.07	196.47	189.64	4.28%	
30-31	30.5	15	30.11	199.42	192.09	4.53%	
31-32	31.5	16	30.07	243.11	232.85	5.06%	
32-33	32.5	17	30.03	223.24	211.31	6.58%	
33-34	33.5	18	29.93	245.04	233.47	5.68%	
34-35	34.5	19	30.12	244.22	234.11	4.96%	
35-36	35.5	20	29.95	249.77	231.26	9.19%	
36-37	36.5	21	30.06	240.73	217.45	12.42%	
37-38	37.5	22	29.98	220.70	202.75	10.39%	
38-39	38.5	23	30.27	230.59	221.51	4.75%	
39-40	39.5	24	30.11	200.80	192.76	4.94%	
40-41	40.5	25	29.94	166.75	160.68	4.64%	
41-42	41.5	26	30.19	201.36	193.23	4.99%	
42-43	42.5	27	30.30	218.60	211.12	4.14%	
43-44	43.5	28	30.19	60.32	59.14	4.08%	
44-45	44.5	29	30.14	180.47	174.45	4.17%	
45-46	45.5	30	30.12	157.36	152.59	3.89%	
46-47	46.5	31	30.18	186.23	180.61	3.74%	
47-48	47.5	32	30.19	42.12	41.69	3.74%	
48-49	48.5	33	30.04	100.85	98.62	3.25%	
49-50	49.5	38	30.17	192.41	186.13	4.03%	
50-51	50.5	43	29.76	218.45	209.96	4.71%	
51-52	51.5	49	30.16	236.38	227.85	4.31%	
52-53	52.5	52	30.07	227.61	217.45	5.42%	
53-54	53.5	53	30.32	250.86	239.69	5.34%	
54-55	54.5	54	30.21	206.62	196.89	5.84%	
55-56	55.5	55	29.86	233.86	222.92	5.67%	

Water Content WL-12 Collection date: 9-Jun-05

Analyst: Karen Waters-Husted Scale Number: 512-06-01-013

Analysis date: 14-Jun-05 Callibration date: 28-Feb-05

Sample ID	Depth (ft)	Beaker No.	Beaker Wt. (g)	Soil/Beaker Wet Wt. (g)	Soil/Beaker Dry Wt. (g)	% Water	Comments
15-16	15.5	1	30.00	226.92	222.52	2.29%	
16-17	16.5	2	30.25	236.74	232.08	2.31%	
17-18	17.5	3	30.17	255.49	250.15	2.43%	
18-19	18.5	4	30.09	233.70	227.04	3.38%	
19-20	19.5	5	30.27	201.59	190.37	7.01%	
20-21	20.5	6	30.26	257.82	246.06	5.45%	
21-22	21.5	7	28.25	214.89	210.56	2.38%	
22-23	22.5	8	30.20	218.23	213.66	2.49%	
23-24	23.5	9	30.27	222.42	218.59	2.03%	
24-25	24.5	10	26.85	71.41	70.67	1.69%	
25-26	25.5	11	30.28	269.73	264.53	2.22%	
26-27	26.5	12	30.00	242.83	237.50	2.57%	
27-28	27.5	13	28.15	244.23	238.96	2.50%	
28-29	28.5	14	30.06	225.26	220.44	2.53%	
29-30	29.5	15	30.11	217.60	212.70	2.68%	
30-31	30.5	16	30.09	255.76	249.69	2.76%	
31-32	31.5	17	30.03	242.34	233.86	4.16%	
32-33	32.5	18	29.93	220.35	215.65	2.53%	
33-34	33.5	19	30.12	197.40	185.81	7.44%	
34-35	34.5	20	29.95	267.42	254.15	5.92%	
35-36	35.5	21	30.07	265.87	255.69	4.51%	
36-37	36.5	22	29.97	248.60	237.34	5.43%	
37-38	37.5	23	30.27	280.55	254.80	11.47%	
38-39	38.5	24	30.11	253.56	245.54	3.72%	
39-40	39.5	25	29.92	202.04	195.04	4.24%	
40-41	40.5	26	30.19	243.00	234.57	4.12%	
41-42	41.5	27	30.29	222.21	214.70	4.07%	
42-43	42.5	28	30.19	223.21	215.55	4.13%	
43-44	43.5	29	30.15	236.45	226.60	5.01%	
44-45	44.5	30	30.11	209.28	200.99	4.85%	
45-46	45.5	31	30.18	236.92	227.49	4.78%	
46-47	46.5	32	30.21	222.11	213.72	4.57%	
47-48	47.5	33	30.04	228.85	219.69	4.83%	
48-49	48.5	38	30.16	245.47	235.17	5.02%	
49-50	49.5	43	29.75	246.15	235.64	5.10%	
50-51	50.5	49	30.16	257.10	245.68	5.30%	
51-52	51.5	52	30.06	254.35	242.47	5.59%	
52-53	52.5	53	30.33	252.41	239.50	6.17%	
53-54	53.5	54	30.21	265.50	252.48	5.86%	
54-55	54.5	55	29.85	270.62	254.34	7.25%	
55-56	55.5	M	30.05	254.74	242.02	6.00%	

Appendix D

Anion Analytical Data

Anions in WELL WL-3A (S-7), ppm											
Sample No	**Depth (ft)**	**Date**	**Dilution**	**Fluoride**	**Chloride**	**Bromide**	**Nitrate**	**Phosphate**	**Sulfate**	**Thiosulfate**	**Comments**
WL_S7_17'	17.5	6/12/2001	1	0.45	8.21	0.03	1.47	0.06	27.9	<0.02	
WL_S7_18'	18.5	6/12/2001	1	0.4	4.83	0.17	0.89	0.07	22.9	<0.02	
WL_S7_19'	19.5	6/12/2001	1	0.45	0.76	0.14	1.15	0.1	11.2	<0.02	
WL_S7_20'	20.5	6/12/2001	1	0.3	0.56	0.1	0.24	0.09	4.93	0.6	
WL_S7_21'	21.5	6/12/2001	1	0.33	0.55	0.03	0.23	0.09	6	<0.02	
WL_S7_22'	22.5	6/12/2001	1	0.39	0.64	0.19	0.39	0.05	6.21	<0.02	
WL_S7_23'	23.5	6/12/2001	1	0.42	0.57	3.18	1.21	0.13	8.34	<0.02	
WL_S7_24'	24.5	6/12/2001	1	0.4	0.6	0.79	0.57	0.09	5.6	0.06	
WL_S7_25'	25.5	6/12/2001	1	0.47	0.65	0.38	0.55	0.08	5.47	0.04	
WL_S7_26'	26.5	6/12/2001	1	0.57	0.72	0.65	0.61	0.09	6.04	<0.02	
WL_S7_27'	27.5	6/12/2001	1	0.5	0.65	0.66	0.53	0.08	6.63	<0.02	
WL_S7_28'	28.5	6/12/2001	1	0.48	0.53	0.71	0.28	0.04	7.3	<0.02	
WL_S7_29'	29.5	6/12/2001	1	0.46	0.56	2.22	0.39	0.04	7	<0.02	
WL_S7_30'	30.5	6/12/2001	1	0.47	0.71	2.04	0.38	0.08	10	<0.02	
WL_S7_31'	31.5	6/12/2001	1	0.53	0.62	0.87	0.56	0.1	10.7	<0.02	
WL_S7_32'	32.5	6/12/2001	1	0.53	0.62	2.13	0.57	0.1	12.5	<0.02	
WL_S7_33'	33.5	6/12/2001	1	0.47	0.89	1.56	1.21	0.07	8.86	<0.02	
WL_S7_34'	34.5	6/12/2001	1	0.43	1.3	2.11	1.68	0.05	10.4	0.03	
WL_S7_35'	35.5	6/12/2001	1	0.41	4.14	0.66	5.19	0.08	18	0.05	
WL_S7_36'	36.5	6/12/2001	1	0.42	6.32	0.16	9.53	0.17	29.2	0.03	
WL_S7_37'	37.5	6/11/2001	1	0.52	9.54	0.06	14.5	0.12	38	<0.02	
WL_S7_38'	38.5	6/11/2001	1	0.37	7.5	0.08	10.7	0.16	27.9	<0.02	
WL_S7_39'	39.5	6/11/2001	1	0.33	3.14	0.05	2.94	0.09	14.6	0.04	
WL_S7_40'	40.5	6/12/2001	1	0.31	3.81	0.02	2.6	0.05	15.2	0.04	
WL_S7_48'	48.5	6/12/2001	1	0.34	2.17	0.01	1.53	0.07	12	0.03	

Note: E- exceeded Upper Quantitation Limit

Anions in WELL WL-4 (S-8), ppm											
Sample No	**Depth (ft)**	**Date**	**Dilution**	**Fluoride**	**Chloride**	**Bromide**	**Nitrate**	**Phosphate**	**Sulfate**	**Thiosulfate**	**Comments**
WL_S8_17'	17.5	6/8/2001	1	1.17	0.61	0.01	1.78	0.2	10.2	0.07	
WL_S8_18'	18.5	6/8/2001	1	1.32	0.77	<0.01	3.16	0.17	10.8	0.09	
WL_S8_19'	19.5	6/8/2001	1	1.39	1.85	0.02	7.04	0.24	17.8	0.11	
WL_S8_20'	20.5	6/8/2001	1	0.95	1.07	0.01	3.84	0.18	12.3	0.1	
WL_S8_21'	21.5	6/8/2001	1	0.69	0.5	0.01	1.51	0.18	10.8	0.02	
WL_S8_22'	22.5	6/8/2001	1	0.56	0.64	0.01	2.1	0.12	10.4	0.05	
WL_S8_23'	23.5	6/8/2001	1	0.58	0.8	0.01	2.67	0.12	8.53	0.12	
WL_S8_24'	24.5	6/8/2001	1	0.47	0.81	0.02	2.39	0.1	7.45	0.12	
WL_S8_28'	28.5	6/8/2001	1	0.65	1.17	0.01	0.85	0.05	11.7	0.11	
WL_S8_32'	32.5	6/8/2001	1	0.52	0.8	0.01	0.43	0.06	11.3	0.11	
WL_S8_35'	35.5	6/8/2001	1	0.6	1.12	1.41	0.81	0.05	10.4	0.09	
WL_S8_36'	36.5	6/8/2001	1	0.46	0.86	3.54	1.18	0.1	9.86	0.03	
WL_S8_37'	37.5	6/8/2001	1	0.48	8.46	9.28	13.3	0.15	42	<0.02	
WL_S8_38'	38.5	6/8/2001	1	0.38	1.49	0.02	3.8	0.09	11.8	0.04	
WL_S8_39'	39.5	6/8/2001	1	0.38	1.5	0.02	3.77	0.1	11.8	0.06	
WL_S8_40'	40.5	6/8/2001	1	0.37	2.46	0.02	4.35	0.08	19.2	0.09	
WL_S8_43'	43.5	6/8/2001	1	0.61	5.47	0.02	3.7	0.06	25.9	0.04	
WL_S8_46'	46.5	6/8/2001	1	0.39	3.46	0.02	2.39	0.07	17.2	0.03	
WL_S8_49'	49.5	6/8/2001	1	0.39	3.85	0.02	2.42	0.06	18.6	0.06	
WL_S8_52'	52.5	6/8/2001	1	0.49	4.41	0.02	2.47	0.05	25.6	0.07	

Note: E- exceeded Upper Quantitation Limit

Anions in WELL WL-5, ppm											
Sample No	**Depth (ft)**	**Date**	**Dilution**	**Fluoride**	**Chloride**	**Bromide**	**Nitrate**	**Phosphate**	**Sulfate**	**Thiosulfate**	**Comments**
WL5_17'	17.5	5/30/2001	1	0.42	28.2	0.09	8.84	<0.01	56.30	0.32	
WL5_18'	18.5	5/30/2001	100	<1	34.5	<1	2.03	<1	589.00	2745	
WL5_19'	19.5	5/30/2001	100	<1	124	<1	1.1	<1	820.00	E	
WL5_19' rerun	19.5	5/31/2001	200							16690	
WL5_20'	20.5	5/30/2001	100	<1	160	<1	1.32	<1	802.00	E	
WL5_20' rerun	20.5	5/31/2001	200							20820	
WL5_21'	21.5	5/30/2001	100	<1	49.2	<1	<1	<1	482.00	7520	
WL5_22'	22.5	5/30/2001	100	<1	66.1	<1	<1	<1	582.00	9964	
WL5_23'	23.5	5/30/2001	100	<1	53.9	<1	<1	<1	633.00	8459	
WL5_24'	24.5	5/30/2001	100	<1	2.11	2.43	<1	<1	187.00	156	
WL5_25'	25.5	5/30/2001	100	<1	1.93	2.97	<1	<1	120.00	15.7	
WL5_26'	26.5	5/30/2001	100	<1	4.4	2.11	<1	<1	435.00	343	
WL5_27'	27.5	5/30/2001	100	<1	3.01	4.40	<1	<1	318.00	176	
WL5_28'	28.5	5/30/2001	100	<1	3.32	5.77	<1	<1	251.00	126	
WL5_29'	29.5	5/30/2001	100	<1	13.5	4.13	<1	<1	623.00	1724	
WL5_30'	30.5	5/30/2001	100	<1	2.72	4.95	<1	<1	282.00	158	
WL5_31'	31.5	5/30/2001	100	<1	1.59	3.05	1.27	<1	31.70	32.7	
WL5_32'	32.5	5/30/2001	100	<1	27.8	2.16	1.9	<1	790.00	3983	
WL5_33'	33.5	5/30/2001	1	0.48	1.81	1.59	2.22	0.02	16.30	0.55	
WL5_34'	34.5	5/31/2001	1	0.42	3.06	0.61	3.75	0.05	16.20	0.1	
WL5_35'	35.5	5/31/2001	1	0.37	5.86	0.14	5.42	0.02	43.50	1.05	
WL5_36'	36.5	5/31/2001	1	0.39	4.62	0.02	4.34	0.04	21.10	0.12	
WL5_37'	37.5	5/31/2001	1	0.33	11.2	0.06	9.96	0.11	41.70	0.14	
WL5_38'	38.5	5/31/2001	1	0.36	8.36	0.04	8.41	0.12	32.10	0.13	
WL5_39'	39.5	5/31/2001	1	0.33	3.24	0.02	2.93	0.07	15.80	0.11	
WL5_40'	40.5	5/31/2001	1	0.35	3.27	0.02	2.81	0.07	16.20	0.09	
WL5_48'	48.5	5/31/2001	1	0.34	4.04	0.01	1.67	0.07	19.40	0.13	

Note: E- exceeded Upper Quantitation Limit

Anions in WELL WL-6, ppm											
Sample No	**Depth (ft)**	**Date**	**Dilution**	**Fluoride**	**Chloride**	**Bromide**	**Nitrate**	**Phosphate**	**Sulfate**	**Thiosulfate**	**Comments**
WL6_18'	18.5	6/1/2001	1	0.66	25.3	1.16	1.61	0.05	89.7	3.98	
WL6_19' rerun	19.5	6/1/2001	1	0.4	4.27	0.99	0.53	0.02	E	14.5	
WL6_19'	19.5	5/31/2001	100						121		
WL6_20'	20.5	5/31/2001	100						143		
WL6_20' rerun	20.5	6/1/2001	1	0.34	2.17	0.4	0.42	0.02	E	30.3	
WL6_21'	21.5	5/31/2001	100						109		
WL6_21' rerun	21.5	6/1/2001	1	0.36	1.78	1.62	0.46	0.02	E	22.8	
WL6_22'	22.5	6/1/2001	1	0.5	1.1	0.71	0.38	0.14	10.3	0.14	
WL6_23'	23.5	6/1/2001	1	0.68	0.67	1.61	1	0.2	12.1	0.11	
WL6_24'	24.5	6/1/2001	1	0.64	0.74	0.64	1.3	0.11	11.9	0.02	
WL6_25'	25.5	6/1/2001	1	0.64	0.92	0.04	2.41	0.04	14.6	0.02	
WL6_26'	26.5	6/1/2001	1	0.6	1.11	0.01	3.39	0.12	18.4	0.05	
WL6_27'	27.5	6/1/2001	1	0.6	1.51	0.02	3.64	0.09	19.3	0.02	
WL6_28'	28.5	6/1/2001	1	0.62	1.61	0.01	4.18	0.13	20.3	0.08	
WL6_29'	29.5	6/1/2001	1	0.6	1.38	0.02	3.83	0.06	19.3	0.02	
WL6_30'	30.5	6/1/2001	1	0.64	1.67	0.09	4.84	0.11	19.5	<0.02	
WL6_31'	31.5	6/1/2001	1	0.61	2.62	0.04	4.7	0.11	18.2	<0.02	
WL6_32'	32.5	6/1/2001	1	0.75	2.34	2.06	4.4	0.09	27.3	0.14	
WL6_33'	33.5	6/1/2001	1	0.61	2.18	0.93	3.81	0.06	15	0.04	
WL6_35'	35.5	6/1/2001	1	0.66	3.62	0.04	6.12	0.1	24.4	0.05	
WL6_36'	36.5	6/1/2001	1	0.67	4.47	0.03	7.01	0.09	24.8	0.03	
WL6_37'	37.5	6/1/2001	1	0.65	7.39	0.04	7.85	0.08	31.7	0.04	
WL6_38'	38.5	6/1/2001	1	0.53	8.79	0.05	10.1	0.16	36.7	<0.02	
WL6_39'	39.5	6/1/2001	1	0.5	3.45	0.02	3.92	0.07	17.4	0.1	
WL6_40'	40.5	6/1/2001	1	0.52	5.28	0.02	1.56	0.06	20.3	0.04	
WL6_48'	48.5	6/1/2001	1	0.48	3.52	0.02	4.02	0.06	17.8	<0.02	

Note: E- exceeded Upper Quantitation Limit

Anions in WELL WL-7, ppm											
Sample No	**Depth (ft)**	**Date**	**Dilution**	**Fluoride**	**Chloride**	**Bromide**	**Nitrate**	**Phosphate**	**Sulfate**	**Thiosulfate**	**Comments**
WL7_17'	17.5	6/1/2001	100	2.28	60.8	<1	5.99	<1	544	95.7	
WL7_18'	18.5	6/1/2001	100	<1	46.9	<1	1.89	<1	645	2703	
WL7_19'	19.5	6/1/2001	100	<1	58	<1	1.34	<1	734	7745	
WL7_20'	20.5	6/1/2001	100	<1	24.9	<1	<1	<1	302	3752	
WL7_21'	21.5	6/1/2001	100	<1	21.8	<1	<1	<1	414	3553	
WL7_22'	22.5	6/4/2001	100	<1	15.6	<1	<1	<1	504	2036	
WL7_23'	23.5	6/4/2001	100	<1	35.9	<1	<1	<1	463	4925	
WL7_24'	24.5	6/4/2001	100	<1	43.1	<1	<1	<1	423	6852	
WL7_25'	25.5	6/4/2001	100	<1	73.4	<1	<1	<1	488	E	
WL7_25'.1	25.5	6/5/2001	200							11460	
WL7_26'	26.5	6/4/2001	100	<1	80.3	<1	<1	<1	528	E	
WL7_26'.1	26.5	6/5/2001	200							12570	
WL7_27'	27.5	6/4/2001	100	<1	122	<1	<1	<1	700	E	
WL7_27'.1	27.5	6/5/2001	300							17810	
WL7_28'	28.5	6/4/2001	100	<1	136	<1	<1	<1	785	E	
WL7_28'.1	28.5	6/5/2001	300							20940	
WL7_29'	29.5	6/4/2001	100	<1	159	<1	<1	<1	664	E	
WL7_29'.1	29.5	6/5/2001	400							23510	
WL7_30'	30.5	6/4/2001	100	<1	161	<1	<1	<1	984	E	
WL7_30'.1	30.5	6/5/2001	400							24410	
WL7_31'	31.5	6/4/2001	100	<1	184	<1	<1	<1	E	E	
WL7_31'.1	31.5	6/5/2001	1000						1138	26490	
WL7_32'	32.5	6/4/2001	100	<1	238	<1	<1	<1	E	E	
WL7_32'.1	32.5	6/5/2001	1000						986	32400	
WL7_33'	33.5	6/4/2001	100	<1	133	<1	<1	<1	E	E	
WL7_33'.1	33.5	6/5/2001	1000						1015	19930	
WL7_34'	34.5	6/4/2001	100	<1	138	<1	<1	<1	E	E	
WL7_34'.1	34.5	6/5/2001	300						1088	20710	
WL7_35'	35.5	6/4/2001	100	<1	146	<1	<1	<1	E	E	
WL7_35'.1	35.5	6/5/2001	300						1241	21390	
WL7_36'	36.5	6/4/2001	100	<1	38.5	<1	<1	<1	739	5488	Sufite=40 (tentatively)
WL7_37'	37.5	6/5/2001	2	0.35	11.1	0.06	7.85	<0.02	136	10.8	
WL7_38'	38.5	6/5/2001	1	0.36	11.5	0.06	10.8	0.01	53.3	0.68	
WL7_40'	40.5	6/5/2001	1	0.43	3.48	<0.01	2.96	0.04	20.8	0.18	
WL7_48'	48.5	6/5/2001	1	0.48	5.44	0.02	2.41	0.05	27.3	0.57	

Note: E- exceeded Upper Quantitation Limit

Anions in WELL WL-8, ppm											
Sample No	Depth (ft)	Date	Dilution	Fluoride	Chloride	Bromide	Nitrate	Phosphate	Sulfate	Thiosulfate	Comments
WL_8_17'	17.5	6/15/2001	1	0.37	22.7	0.07	1.53	0.06	27.7	0.12	
WL_8_18'	18.5	6/14/2001	2	0.31	30.6	0.88	2.17	<0.01	155	8.1	
WL_8_19'	19.5	6/13/2001	100	<1	35.1	<1	<1	45.4	945	3817	
WL_8_20'	20.5	6/13/2001	100	<1	62.9	<1	<1	49.5	1390	8118	
WL_8_21'	21.5	6/13/2001	100	<1	13	1.83	<1	<1	783	1598	
WL_8_22'	22.5	6/13/2001	100	<1	7.4	2.06	<1	<1	604	672	
WL_8_23'	23.5	6/15/2001	3	0.38	2.98	1.54	0.22	<0.03	364	60.4	
WL_8_24'	24.5	6/15/2001	1	0.5	0.85	0.58	1.68	0.15	13.3	0.18	
WL_8_25'	25.5	6/15/2001	1	0.56	0.84	0.02	1.93	0.12	15.6	0.18	
WL_8_26'	26.5	6/15/2001	1	0.56	0.97	0.01	2.51	0.08	18.6	0.13	
WL_8_27'	27.5	6/15/2001	1	0.55	1.77	0.02	3.6	0.06	20.4	0.11	
WL_8_28'	28.5	6/15/2001	1	0.53	1.83	0.02	3.77	0.06	20.2	0.09	
WL_8_29'	29.5	6/15/2001	1	0.54	2.03	0.02	4.37	0.07	28.4	0.2	
WL_8_30'	30.5	6/15/2001	1	0.48	2.19	0.02	4.63	0.08	25.3	0.09	
WL_8_31'	31.5	6/15/2001	1	0.46	3.45	0.02	5.02	0.07	27.2	0.11	
WL_8_32'	32.5	6/15/2001	100	<1	39.8	<1	2.94	3.34	1276	5191	
WL_8_33'	33.5	6/15/2001	2	0.39	3.92	1.11	4.12	<0.02	181.4	16.2	
WL_8_34'	34.5	6/15/2001	1	0.45	5.36	0.49	6.08	0.08	34.2	0.09	
WL_8_35'	35.5	6/15/2001	1	0.48	6.11	0.1	6.18	0.1	29.2	0.11	
WL_8_36'	36.5	6/15/2001	1	0.46	7.76	0.06	7.78	0.12	39	0.28	
WL_8_37'	37.5	6/15/2001	1	0.46	8.96	0.06	7.9	0.09	39.1	0.27	
WL_8_38'	38.5	6/15/2001	1	0.48	10.5	0.05	10.1	0.05	42.7	0.22	
WL_8_39'	39.5	6/15/2001	1	0.42	3.75	0.03	3.39	0.07	18.7	0.13	
WL_8_40'	40.5	6/15/2001	1	0.49	3.29	0.03	3.11	0.09	21.6	0.14	
WL_8_48'	48.5	6/14/2001	1	0.52	3.72	0.02	1.17	0.07	36.3	0.37	

Note: E- exceeded Upper Quantitation Limit

Anions in WELL WL-9, ppm										
Sample No	Depth (ft)	Date	Dilution	Fluoride	Chloride	Bromide	Nitrate	Phosphate	Sulfate	Thiosulfate
WL_9_17'	17.5	6/20/2001	1	0.64	0.9	<0.01	4.41	0.14	28.2	0.42
WL_9_18'	18.5	6/20/2001	1	0.65	1.21	0.16	4.73	0.1	30.5	0.42
WL_9_19'	19.5	6/20/2001	10	0.31	4.86	1.12	2.47	0.13	426	215
WL_9_20'	20.5	6/20/2001	200	<2	111	<2	<2	5.45	1422	16193
WL_9_21'	21.5	6/20/2001	200	<2	78	<2	4.43	4.83	1273	11970
WL_9_22'	22.5	6/19/2001	100	<1	9.93	1.11	1.29	<1	629	910
WL_9_23'	23.5	6/20/2001	1	0.64	0.91	0.13	2.23	0.07	52.2	2.9
WL_9_25'	25.5	6/20/2001	1	0.66	1	0.02	2.39	0.07	29.6	0.58
WL_9_26'	26.5	6/20/2001	1	0.67	1.52	0.02	3.84	0.07	31.4	0.37
WL_9_27'	27.5	6/20/2001	1	0.64	1.7	0.01	3.64	0.04	42.6	0.68
WL_9_28'	28.5	6/20/2001	1	0.67	2.5	0.02	3.04	0.07	40.1	0.57
WL_9_29'	29.5	6/20/2001	1	0.63	2.37	0.01	1.65	0.07	26	0.31
WL_9_30'	30.5	6/20/2001	1	0.65	2.12	0.01	1.3	0.11	29.2	0.34
WL_9_31'	31.5	6/20/2001	1	0.62	1.23	0.01	0.72	0.08	34.1	0.28
WL_9_32'	32.5	6/19/2001	100	<1	16.5	1	1.03	<1	775	1470
WL_9_33'	33.5	6/19/2001	100	<1	37.7	1.16	1.89	1.89	1055	4535
WL_9_34'	34.5	6/19/2001	100	<1	31.9	1.48	<1	1.78	1190	3854
WL_9_35'	35.5	6/19/2001	100	<1	54.1	1.67	<1	2.68	1363	6820
WL_9_36'	36.5	6/20/2001	300	<3	126	3.38	5.27	<3	1732	16230
WL_9_37'	37.5	6/20/2001	500	<5	186	<5	<5	<5	1460	27810
WL_9_38'	38.5	6/19/2001	100	<1	10.5	1.87	1.64	1.14	546	1049
WL_9_39'	39.5	6/19/2001	100	<1	12.2	1.86	3.34	2.02	457	981
WL_9_40'	40.5	6/20/2001	1	0.51	5.46	0.29	6.79	0.08	87.9	2.68
WL_9_48'	48.5	6/20/2001	1	0.5	4.19	0.02	3.69	0.09	33.7	0.74
WL_9_52'	52.5	8/21/2001	1	0.34	19.5	0.07	1.44	<0.01	E	I
WL_9_52' rerun	52.5	8/22/2001	20						1194	2.42
WL_9_53'	53.5	8/21/2001	1	0.44	21.1	0.06	1.99	<0.01	E	I
WL_9_53' rerun	53.5	8/22/2001	20						1708	1.34
WL_9_54'	54.5	8/21/2001	1	0.62	29.7	0.07	4.42	0.01	E	E
WL_9_54' rerun	54.5	8/22/2001	400						817	839
WL_9_55'	55.5	8/21/2001	1	0.6	11.2	0.04	3.8	0.04	E	0.71
WL_9_55' rerun	55.5	8/22/2001	2						166	
WL_9_56'	56.5	8/21/2001	1	0.61	7.81	0.03	1.86	0.03	57.8	0.03

Note: E- exceeded Upper Quantitation Limit

Anions in WELL WL-10, ppm											
Sample No	**Depth (ft)**	**Date**	**Dilution**	**Fluoride**	**Chloride**	**Bromide**	**Nitrate**	**Phosphate**	**Sulfate**	**Thiosulfate**	**Comments**
WL_10_17'	17.5	6/22/2001	1	0.48	4.64	0.03	1.5	0.08	38.6	0.21	
WL_10_18'	18.5	6/21/2001	100	<1	9.84	<1	<1	<1	590	420	
WL_10_19'	19.5	6/21/2001	100	<1	5.2	<1	<1	1.76	337	320	
WL_10_20'	20.5	6/21/2001	100	<1	5.1	<1	<1	1.03	319	338	
WL_10_21'	21.5	6/21/2001	100	<1	4.5	<1	<1		328	284	
WL_10_22'	22.5	6/21/2001	100	<1	17.2	<1	<1	1.1	417	2015	
WL_10_23'	23.5	6/21/2001	100	<1	12.8	<1	<1	1.14	289	1583	
WL_10_24'	24.5	6/21/2001	100	<1	11.8	<1	<1	1	380	1421	
WL_10_25'	25.5	6/21/2001	100	<1	14.1	<1	<1	<1	471	1775	
WL_10_26'	26.5	6/21/2001	100	<1	17.2	<1	<1	1.15	475	2211	
WL_10_27'	27.5	6/21/2001	100	<1	20.2	<1	<1	1.19	461	2675	
WL_10_28'	28.5	6/21/2001	100	<1	39.5	<1	<1	<1	402	5746	
WL_10_29'	29.5	6/21/2001	100	<1	68.2	<1	<1	<1	663	E	
WL_10_29' rerun	29.5	6/22/2001	200							10214	
WL_10_30'	30.5	6/21/2001	100	<1	98.4	<1	<1	2.04	793	E	
WL_10_30' rerun	30.5	6/22/2001	200							14860	
WL_10_31'	31.5	6/21/2001	100	<1	134	<1	<1	1.33	E	E	
WL_10_31' rerun	31.5	6/22/2001	300						913	19600	
WL_10_32'	32.5	6/21/2001	100	<1	80.1	<1	<1	<1	733	E	
WL_10_32' rerun	32.5	6/22/2001	200							11640	
WL_10_33'	33.5	6/21/2001	100	<1	50.7	<1	<1	<1	430	7413	
WL_10_34'	34.5	6/21/2001	100	<1	82	<1	<1	1.36	673	E	
WL_10_34' rerun	34.5	6/22/2001	200							12220	
WL_10_35'	35.5	6/21/2001	100	<1	123	1.23	<1	2.98	587	E	
WL_10_35' rerun	35.5	6/22/2001	300							17890	
WL_10_36'	36.5	6/21/2001	100	<1	189	<1	<1	3.47	E	E	
WL_10_36' rerun	36.5	6/22/2001	500						923	27200	
WL_10_38'	38.5	6/21/2001	100	<1	159	<1	1.97	4.16	905	E	
WL_10_38' rerun	38.5	6/22/2001	500							23620	
WL_10_39'	39.5	6/21/2001	100	<1	13.8	<1	3.27	<1	601	1294	
WL_10_40'	40.5	6/21/2001	100	<1	6.37	<1	4.53	7.04	241	249	
WL_10_48'	48.5	6/22/2001	100	0.38	2.72	0.01	2.27	0.04	17.2	<0.02	
WL_10_51'	51.5	8/21/2001	1	0.59	5.33	0.02	0.1	0.02	48.1	0.03	
WL_10_52'	52.5	8/21/2001	1	0.64	5.79	0.02	0.71	0.05	51.6	<0.02	
WL_10_53'	53.5	8/21/2001	1	0.43	5.43	0.03	0.01	1.05	E	39.5	
WL_10_53' rerun	53.5	8/22/2001	4						282		
WL_10_54'	54.5	8/21/2001	1	0.47	3.51	0.02	0.53	0.03	41.4	<0.02	
WL_10_55'	55.5	8/21/2001	1	0.58	8.88	0.04	1.58	0.01	55.4	<0.02	

Note: E- exceeded Upper Quantitation Limit

Anions in WELL W -11, ppm											
Sample No	**Depth (ft)**	**Date**	**Dilution**	**Fluoride**	**Chloride**	**Bromide**	**Nitrate**	**Phosphate**	**Sulfate**	**Thiosulfate**	**Comments**
WL_11_17'	17.5	6/22/2001	1	0.65	1.64	0.01	3.9	0.16	28.5	0.45	
WL_11_18'	18.5	6/22/2001	100	<1	9.3	<1	2.78	<1	425	376	
WL_11_19'	19.5	6/22/2001	100	<1	20.9	<1	<1	1.42	620	2263	
WL_11_20'	20.5	6/22/2001	100	<1	37.7	<1	<1	<1	503	5598	
WL_11_21'	21.5	6/22/2001	100	<1	86.5	<1	<1	1.49	576	E	
WL_11_21' rerun	21.5	6/25/2001	200							13710	
WL_11_23'	23.5	6/22/2001	100	<1	4.03	<1	1.85	<1	205	219	
WL_11_24'	24.5	6/22/2001	100	<1	6.23	<1	2.07	4.11	298	487	
WL_11_25'	25.5	6/22/2001	100	<1	35.5	<1	1.4	<1	644	4138	
WL_11_26'	26.5	6/22/2001	100	<1	17.4	<1	1.69	<1	770	2084	
WL_11_27'	27.5	6/22/2001	100	<1	3.38	3.7	<1	<1	355	33.4	
WL_11_28'	28.5	6/25/2001	1	0.56	1.16	4.55	1.05	0.06	88.3	0.08	
WL_11_29'	29.5	6/22/2001	100						168		
WL_11_29' rerun	29.5	6/25/2001	1	0.48	1.98	3.87	0.73	0.06	E	14.1	
WL_11_30'	30.5	6/25/2001	2	0.52	1.72	1.91	0.99	0.06	213	0.06	
WL_11_31'	31.5	6/25/2001	1	0.62	2.22	0.86	4.95	0.06	42.5	0.12	
WL_11_32'	32.5	6/22/2001	100	<1	22.7	<1	1.91	1.28	589	2442	
WL_11_33'	33.5	6/22/2001	100	<1	32.9	<1	<1	<1	676	4384	
WL_11_34'	34.5	6/22/2001	100	<1	41.9	<1	<1	<1	638	6105	
WL_11_35'	35.5	6/22/2001	100	<1	93	<1	<1	1.58	705	E	
WL_11_35' rerun	35.5	6/25/2001	200							15460	
WL_11_36'	36.5	6/25/2001	100	<1	236	<1	<1	9.01	951	E	
WL_11_36' rerun	36.5	6/26/2001	1000							30030	
WL_11_37'	37.5	6/25/2001	100	<1	234	<1	<1	9.82	852	E	
WL_11_37' rerun	37.5	6/26/2001	1000							30060	
WL_11_38'	38.5	6/25/2001	100	<1	82.9	<1	<1	5.6	493	E	
WL_11_38' rerun	38.5	6/26/2001	300							11560	
WL_11_39'	39.5	6/25/2001	100	<1	81.7	<1	<1	2.98	462	E	
WL_11_39' rerun	39.5	6/26/2001	300							11520	
WL_11_40'	40.5	6/25/2001	100	<1	65	<1	<1	3.35	532	E	
WL_11_40' rerun	40.5	6/26/2001	300							8940	
WL_11_48'	48.5	6/25/2001	1	0.36	7.11	0.01	5.58	0.07	E	E	
WL_11_48' rerun	48.5	6/26/2001	3						152	132	
WL_11_51'	51.5	8/21/2001	1	1.27	41.2	0.09	3.06	<0.01	E	E	
WL_11_51' rerun	51.5	8/22/2001	400						808	2904	
WL_11_52'	52.5	8/21/2001	1	1.62	43.3	0.09	5	I	E	E	
WL_11_52' rerun	52.5	8/22/2001	400					1.36	1073	2741	
WL_11_53'	53.5	8/21/2001	1	0.49	15.6	0.05	4.77	0.14	E	53.5	
WL_11_53' rerun	53.5	8/23/2001	10						818		
WL_11_54'	54.5	8/21/2001	1	0.88	36.6	0.09	5.18	I	E	E	
WL_11_54' rerun	54.5	8/22/2001	400					3.85	1159	1754	
WL_11_55'	55.5	8/21/2001	1	0.47	13.7	0.06	3.31	0.11	E	E	
WL_11_55' rerun	55.5	8/23/2001	10						640	206	

Note: E- exceeded Upper Quantitation Limit

Anions in WELL W -12, ppm											
Sample No	**Depth (ft)**	**Date**	**Dilution**	**Fluoride**	**Chloride**	**Bromide**	**Nitrate**	**Phosphate**	**Sulfate**	**Thiosulfate**	**Comments**
WL_12_17'	17.5	6/27/2001	1	1.6	1	0.01	2.91	0.23	21.7	0.76	
WL_12_18'	18.5	6/28/2001	1	1.59	1.26	0.02	5.79	0.19	25.4	0.54	
WL_12_19'	19.5	6/27/2001	100	<1	23.8	1.58	1.31	21.8	749	3638	
WL_12_20'	20.5	6/27/2001	100	<1	8.55	2.01	<1	<1	621	1058	
WL_12_21'	21.5	6/28/2001	1	0.68	0.75	0.1	1.78	0.15	21.1	0.78	
WL_12_22'	22.5	6/28/2001	1	0.73	0.71	0.01	2.34	0.16	20.5	0.8	
WL_12_23'	23.5	6/28/2001	1	0.53	0.77	0.01	2.52	0.13	16.2	0.46	
WL_12_24'	24.5	6/28/2001	1	0.59	0.83	0.01	2.43	0.06	35.4	1.82	
WL_12_25'	25.5	6/28/2001	1	0.64	1.69	0.02	2.39	0.12	20.2	0.54	
WL_12_26'	26.5	6/28/2001	1	0.56	1.64	0.01	1.69	0.1	22.8	0.41	
WL_12_27'	27.5	6/28/2001	1	0.55	1.12	0.01	0.92	0.08	21.2	0.71	
WL_12_28'	28.5	6/28/2001	1	0.53	0.76	0.01	0.54	0.09	22.5	0.4	
WL_12_29'	29.5	6/28/2001	1	0.51	0.73	0.01	0.44	0.12	23.8	0.43	
WL_12_30'	30.5	6/28/2001	1	0.47	0.62	<0.01	0.35	0.1	21.7	0.28	
WL_12_31'	31.5	6/27/2001	100	<1	9.79	<1	1.45	<1	513	617	
WL_12_32'	32.5	6/27/2001	100	<1	3.01	<1	1.26	1.04	199	85.1	
WL_12_33'	33.5	6/27/2001	100	<1	41.4	2.15	1.7	29.3	1078	5437	
WL_12_34'	34.5	6/27/2001	100	<1	72.7	<1	<1	1.97	1069	E	
WL_12_34' rerun	34.5	6/28/2001	300							11620	
WL_12_35'	35.5	6/27/2001	100	<1	39.4	1.01	<1	1.59	810	5881	
WL_12_36'	36.5	6/27/2001	100	<1	24.3	3.68	1.68	1.3	727	3145	
WL_12_37'	37.5	6/27/2001	100	<1	101	6.15	2.08	2.8	1718	E	
WL_12_37' rerun	37.5	6/28/2001	300							15290	
WL_12_38'	38.5	6/27/2001	100	<1	11.3	1.98	1.6	<1	626	1295	
WL_12_39'	39.5	6/27/2001	100	<1	13	<1	3.35	<1	464	1331	
WL_12_40'	40.5	6/27/2001	100	<1	7.99	1.28	4.99	1.17	411	248	
WL_12_48'	48.5	6/28/2001	300	<3	43.5	<3	<3	4.49	775	5374	
WL_12_51'	51.5	8/21/2001	100	1.33	68.5	<1	4.45	<1	1205	9081	
WL_12_52'	52.5	8/21/2001	100	0.49	63.1	<1	2.84	<1	1109	8084	
WL_12_53'	53.5	8/21/2001	100	0.55	20.6	<1	1.01	1.6	613	2506	
WL_12_54'	54.5	8/21/2001	100	0.56	33.4	<1	2.17	<1	707	4297	
WL_12_55'	55.5	8/21/2001	100	0.51	38.9	<1	2.53	<1	901	5261	

Note: E- exceeded Upper Quantitation Limit

Distribution

No. of Copies

OFFSITE

5 T. G. Caldwell
Earth and Ecosystem Science
Desert Research Institute
2215 Raggio Parkway
Reno, NV 89512

ONSITE

4 **DOE Richland Operations Office**

B. L. Foley	H0-12
J. P. Hanson	K8-50
R. D. Hildebrand	A5-13
K. M. Thompson	A5-13

3 **Bechtel Hanford, Inc.**

K. R. Fecht	H0-02
B. H. Ford	H0-21
M. J. Graham	H0-09

No. of Copies

CH2M HILL Hanford Group

F. M. Mann	H0-22

Fluor Federal Services

R. Khaleel	B4-43

25 **Pacific Northwest National Laboratory**

M. J. Fayer	K9-33
M. D. Freshley	H0-21
G. W. Gee (5)	K9-33
D. G. Horton	K6-81
G. V. Last (5)	K6-81
W. J. Martin	K6-81
G. W. McNair	H0-21
P. D. Meyer	BPO
A. T. Owen (5)	K6-81
S. P. Reidel	K6-81
A. L. Ward	K9-33
F. Z. Zhang	K9-33
Hanford Technical Library (2)	P8-55